THE MODEL ENGINEER

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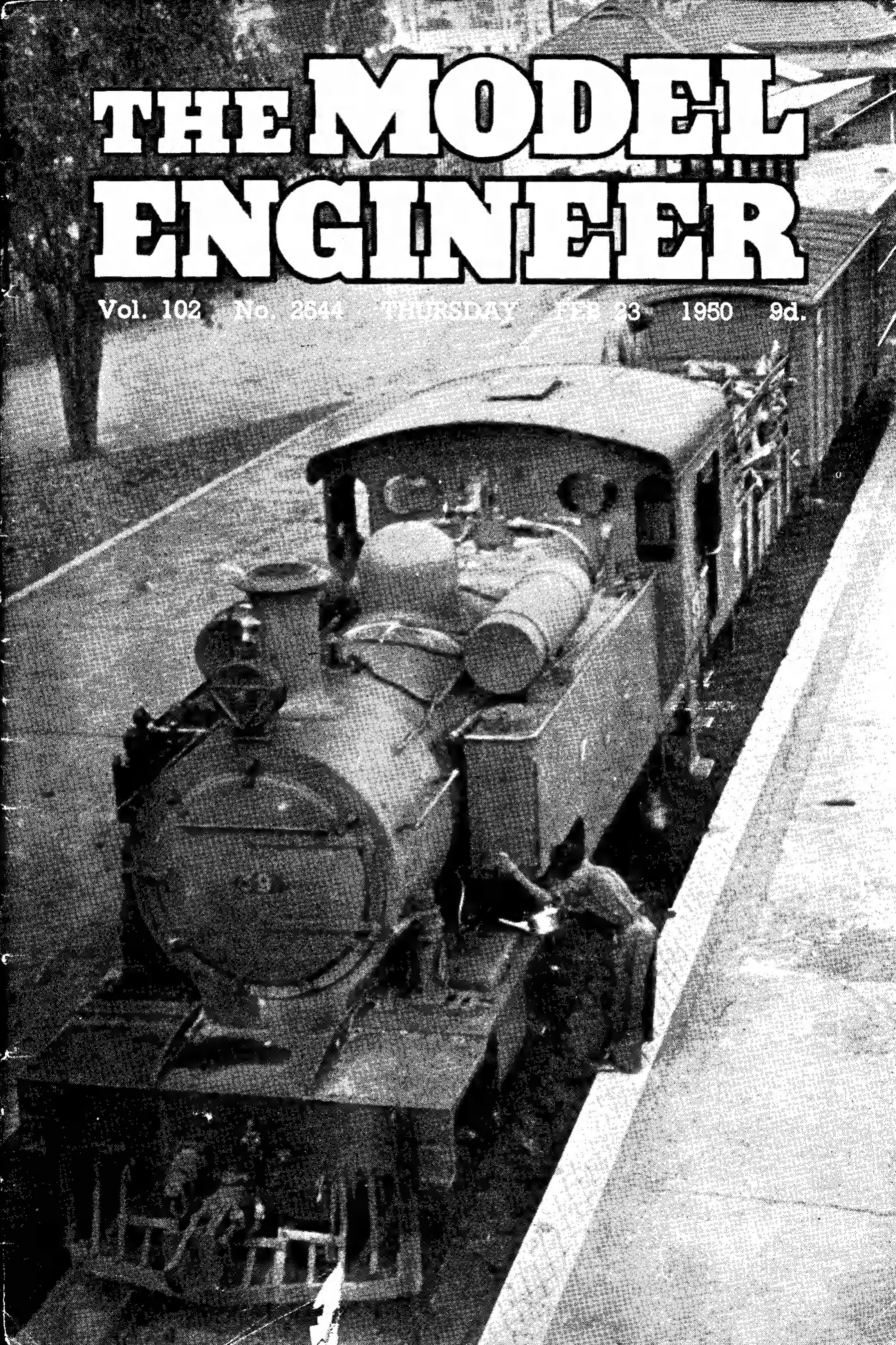


The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

23RD FEBRUARY, 1950 VOL. 102 NO. 2544

SMOKE RINGS

Our Cover Picture

● RAILWAY ENTHUSIASTS may be interested in the scene depicted on our cover this week, if only to compare it with almost any comparable scene in Britain. The original photograph was taken by Mr. B. A. Wyndham, of London, W.14, when he was recently in Kenya; it shows an East African Railways 2-6-4 tank locomotive at Nairobi. The railway is of metre gauge and was formerly known as the Kenya-Uganda Railway until it was reorganised and re-titled some time ago. The driver and fireman are African, an indication of the fact that native crews are becoming more and more prevalent on the railways of Africa.

To "Lead—or be Led?"

● MR. K. N. HARRIS's letter under the above heading, published in our issue of January 19th, has, as we rather expected, brought in a number of other letters which, if published, would only give rise to one of those interminable discussions that lead to no useful practical result. We thank all those correspondents who took the trouble to write on this matter; but since the editorial policy of THE MODEL ENGINEER was, to some extent, laid open to question, we feel justified in making a reply.

THE MODEL ENGINEER caters for a *hobby*, and does not presume to compete with those whose job it is to provide technical education and training for craftsmen. But where basic principles are involved in a new design of any kind, good and sufficient explanation is usually forthcoming, if only briefly, in our pages.

The great majority of our readers are not technically trained in physics, electricity, mechanics, mathematics, or other branches of science which are normally included in technical education; in fact, some of our readers even lack a knowledge of the rudiments of simple arithmetic! Yet, among such men are to be found some of the most expert of model-makers who indulge in the hobby for the sheer love of making something and making it well; to them, it is the *result* that matters more than any consideration or thought of the principles governing the means whereby the result is obtained.

This must not be taken to mean that we either applaud or denounce a lack of knowledge of basic principles; the point is that we are not concerned with it, one way or the other. Our province is to guide anyone who wishes to be guided how to utilise his spare time in developing his creative instincts, occupying his mind and using his hands, to produce something worth producing, and enjoy not only the doing of it but also the result of the process.

The number of model engineers in this country is greater than ever before, and we know quite well that if there were anything wrong with our policy, we would soon be advised of it.

We believe that the majority of our readers support our claim to *lead* and not to follow.

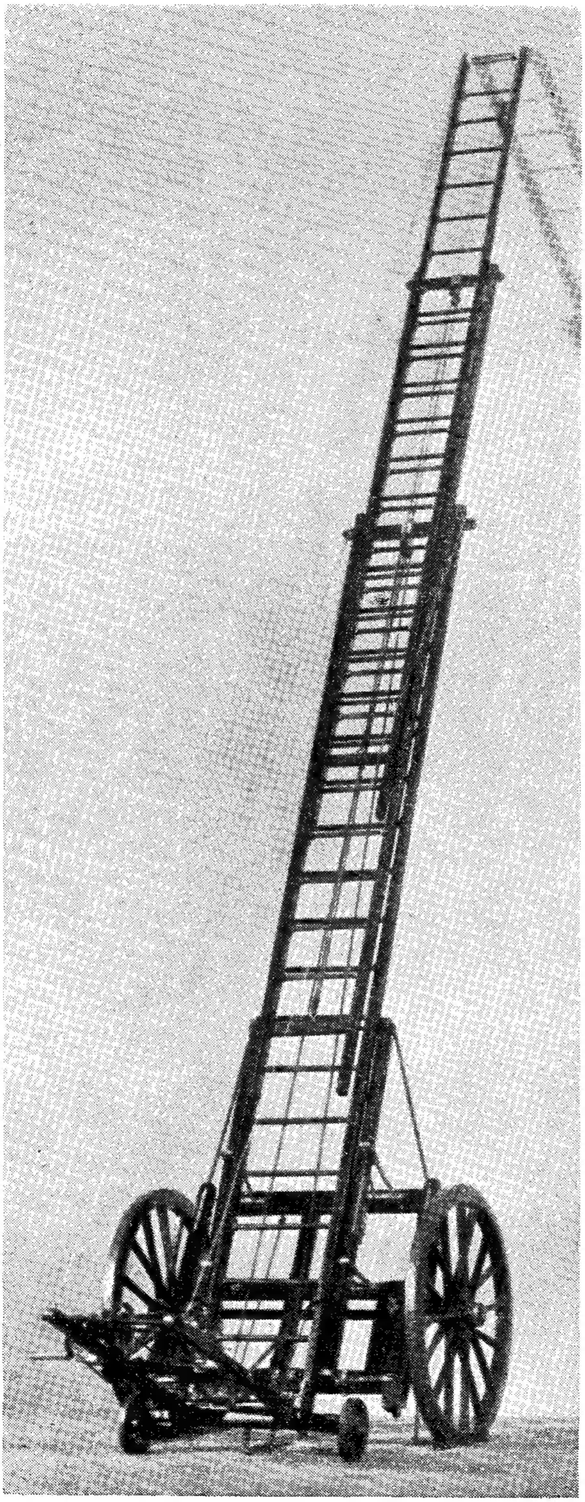
A Model Fire Escape

● IN "SMOKE RINGS" in our Christmas issue, we referred to a model fire escape which we had inspected at the Building Exhibition at Olympia. We are very pleased to have received a letter, together with the photograph reproduced on this page, from its builder, Mr. J. W. Lloyd, of Deptford, who writes :

"What a grand surprise your Christmas issue was to me! There, on the first page, was a reference to my 'first model.' I was the builder of the fire escape which you saw at Olympia.

I first started taking THE MODEL ENGINEER about a year ago, and it created in me an urge to build a model. What better than a replica of the very machine that I drive (I am a fireman). Well 600 hours later the model was finished and now lies in the museum of the Fire Protection Association. It has given me great pleasure to build, but the greatest moment for me was when I opened your Christmas issue.

"You were correct in your assumption that the scale of the model is 1 in. to the foot. Every part was made by myself, including the chain which comprises more than 200 links. Hand tools were used throughout, mainly a file, a hacksaw, a hand drill and the inevitable soldering-iron. The photograph was taken by a friend, Mr. Lund."



With that, we will let the photograph speak for itself. We would like to add, however, that we admire Mr. Lloyd's industry, enthusiasm and ingenuity in the use of simple, homely tools. If he can produce such a nice job in those circumstances, we wonder what the result would be if he were let loose in a fully-equipped workshop!

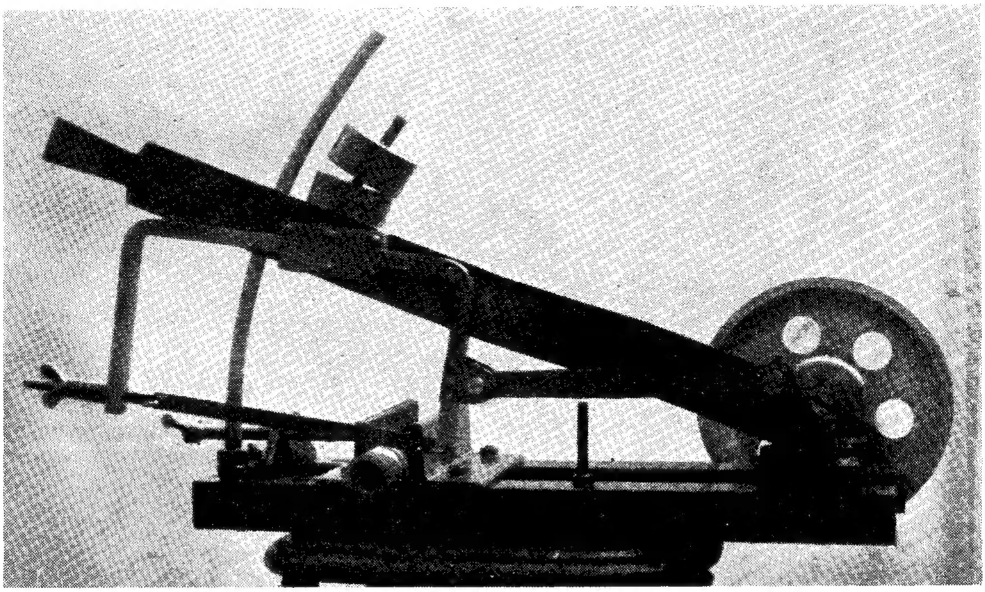
A New Staffordshire Club

● WE LEARN that a new model engineering club has been formed in the Blackheath (Staffs) area, under the title of The Blackheath (Staffs) and District Model Engineering Society. The hon. secretary is Mr. F. Millership, 107, Shenstone Valley Road, Quinton, Birmingham 32, who tells us that, judging by the attendance at the inaugural meeting, the success of the new club is assured; he will be pleased, however, to hear from anyone who would be interested in joining the club. An exhibition is being planned, to be held at the Halesowen Rotary Club from April 24th to 29th next.

A Belt-Driven Hacksaw Machine

by R. F. M. Woodforde

THIS machine uses ordinary 8 or 9-in. saw blades and will cut metals up to 3 in. × 3 in. It is intended to be bolted, or screwed, to the bench, and to be driven off the lathe pulley, or from a separate motor through countershafts. Its correct speed is 50 r.p.m. When the job is cut through, the saw frame drops on to a stud and you will know that the job is cut, either by the falling of the piece, or an increase in the motor speed. A switch to cut out the motor could easily be arranged if desired. The total cost of materials should not exceed 40s., a $\frac{1}{4}$ h.p. motor being amply sufficient.



A side view of the belt-driven hacksaw machine

Bed Plate

This is shown at *A* in both drawings. It consists of two pieces of angle-iron 21 in. × $1\frac{1}{2}$ in. × $\frac{1}{4}$ in.; if one happens to have 2 in. in stock, this will do. It is stiffened at the driving end with a piece of $\frac{1}{4}$-in. iron plate $5\frac{1}{2}$ in. × 3 in. and to this, the pedestal bearings, which are castings, *B* are bolted with $\frac{5}{16}$-in. bolts through pedestal, stiffener and angles. These four bolts must be $1\frac{5}{8}$ in. long.

The pedestals are filed up, mounted on an angle-plate in the lathe, after the holding-down holes are drilled $\frac{5}{16}$ in. clear. They are then drilled and bored a nice running fit for a $\frac{5}{8}$ in. dia. mild-steel shaft. The holding-down bolts are $2\frac{3}{8}$ in. centres; the faces should be pin-drilled, and owing to restricted space, $\frac{1}{4}$-in. nuts tapped $\frac{5}{16}$ in. may be used. The bearing faces are skimmed up whilst on the faceplate.

The angle-piece *R* is cleaned up, drilled $\frac{11}{16}$ in., the centres being $2\frac{1}{8}$ in. It is bolted to the faceplate, drilled and bored $\frac{5}{8}$ in. a running fit to the shaft and its end is faced up so that it is a nice fit between the bearing faces with no end play. Some packing will be needed between it and the faceplate.

Shaft

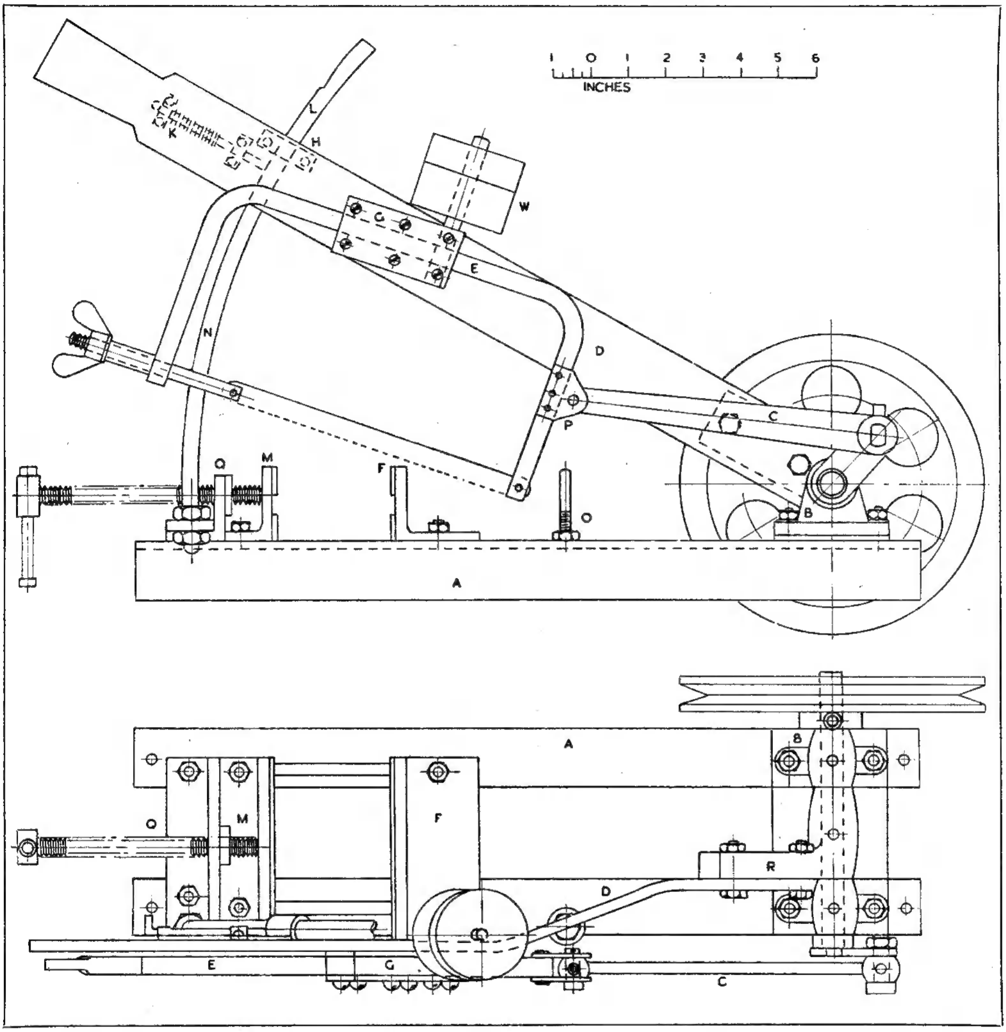
This is $\frac{5}{8}$-in. mild-steel. It must be 8 in. at first, and can be cut when a suitable pulley is obtained. One end is turned down to a shade over $\frac{1}{2}$ in., and $\frac{1}{4}$ in. long; it can be put in the three-jaw chuck and a steady.

Crank

This is a piece of mild-steel 1 in. × $\frac{1}{4}$ in. It is $1\frac{3}{4}$-in. throw, drilled $\frac{1}{2}$ in. at one end and slightly countersunk, a force fit to the shaft. The outside end is drilled and tapped $\frac{3}{8}$ in. Whit.; great care must be taken to get the tap square both ways, using a small square viewed several times during the operation. It must also be set square on the shaft and then brazed in place. A large flower-pot set bottom up is a handy stand, whilst this is being done. A good spelter such as "Easyflo" may be used and a

largish blowlamp, some coke, or asbestos sheet will conserve the heat. The shaft and crank can now be put in place, also the angle-piece. A small distance-piece $\frac{5}{8}$ in. bore is placed between the crank and bearing long enough to allow the lock-nut of the crankpin to clear the bed, etc. It will probably be about $\frac{1}{2}$ in. long, but a trial is the distance-piece is known, also a distance-piece may be required at the pulley end.

The connecting-rod is a casting, with the big-end drilled letter U and reamed to $\frac{3}{8}$ in., the bosses being filed up, and in this runs a $\frac{3}{8}$ in. M.S. crankpin. It is about $1\frac{3}{8}$ in. long, screwed for $\frac{5}{8}$ in., a nice fit to the connecting-rod, and

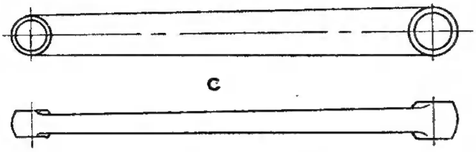


needed. The crank and shaft should now be nice and free; when in place, however, a thin shim of copper "4 thou" may be needed under one, or other, pedestal.

The pulley is 8 in. in diameter, V type preferred. It may be too big for the maker's lathe and can be obtained from Gamages, Holborn (or other firms), $\frac{5}{8}$ in. bore. These are tapped $\frac{1}{4}$ in. Whit, and the grub-screw must be replaced by a $\frac{1}{4}$ in. cheese-head screw, locked with a nut, the end of which is pointed and sunk well into the shaft. However, this must be left until the thickness of locked in place with a thin lock-nut. However, make sure of the length before cutting it dead length. The small-end is drilled, letter N drill, and reamed $\frac{5}{16}$ in., care being taken to get these drills and reamers square both ways. The small-end pin is $\frac{5}{16}$ in. M.S. 1 in. long, and drilled to take a $\frac{1}{16}$-in. split pin. Both these pins look much better if the heads are turned round, and cut to about half the standard thickness, in which case the $\frac{3}{8}$-in. pin can be filed on two opposite faces to fit a $\frac{5}{16}$-in. Whit. spanner. It may be mentioned that a "sloppy" fit will make the machine

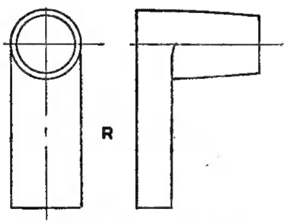
"knock" badly, so if such a fit is made, either of two remedies can be applied: bore the hole out larger and force in a brass bush, or turn an oversized pin.

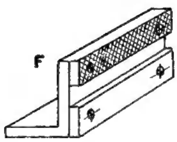
The rocking lever *D* is an iron bar 24 in. × 2 in. × $\frac{1}{4}$ in. It is bolted to the angle-piece by two $\frac{5}{16}$-in. bolts. At the top end a handle 3 in. long is cut. This lever is set out as shown in the plan to about 2 in. more or less. This can be done in the vice cold (N.B., when the use of a vice is mentioned in this article it is always to be fitted



with heavy copper jaws to avoid damage to the job), but sharper, and better-looking bends can be made with the job hot.

The saw frame *E* is the next job. It is bent from a 3 ft. length of $\frac{1}{2}$ in. square M.S. It is bent at a nice bright red-heat in the vice jaws, so as to be $9\frac{5}{8}$ in. between the legs. A tin template is best cut with two rounded corners and here $\frac{1}{8}$ in. is allowable either way. If the steel is held in the vice, and a good blowlamp used right up to the jaws, it will give a bend about $1\frac{1}{2}$ in. from the jaw end and about 12 in. may stick out from the vice before the first bend. The ends cut off are used later on. A piece of gas-, or steam-pipe, slipped over the end is a great help whilst bending. Set the ends square whilst hot, also take out any twist by means of a long adjustable spanner. One leg is cut $5\frac{1}{2}$ in. long and one $5\frac{1}{4}$ in., inside measurements. These ends are squared up with the file. The shorter end is carefully marked 5 in. down and drilled $\frac{1}{8}$ in. to receive the pin. It is carefully marked with the jennies and split up $\frac{5}{8}$ in., and with a circular splitting saw in the lathe this is an easy job. By hand, it requires some care. Mark two lines both sides of the

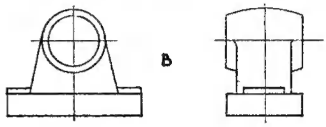




steel, and at the end about $\frac{1}{16}$ in. apart. Unless you are an expert with a hacksaw, do not attempt to cut straight down, but cut each side with the saw, at about 45 deg., then cut away the middle. Take several looks to see that you are keeping straight during this job. The longer leg is drilled at 5 in. with a 19/64-in. drill, care being taken to keep it central. This is filed out $\frac{5}{16}$ in. square by means of a small square file, and takes some careful work. The corners can be taken out with a very small half-round file. A piece of $\frac{5}{16}$ in. square M.S. slides in this, and its corners will need filing off a little.

The blade stretcher is a piece of $\frac{5}{16}$ in. M.S. $4\frac{1}{4}$ in. long. It is turned or filed down $1\frac{3}{4}$ in. long and screwed $\frac{5}{16}$-in. Whit. to take a wing-nut. It is also drilled, and split, like the saw frame. A piece of tube that will slip over the square part is cut $1\frac{1}{4}$ in. long and a $\frac{5}{16}$-in. washer put between the nut and the tube. This tube allows an 8-in. or 9-in. blade to be used.

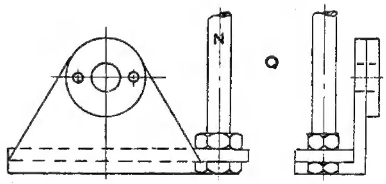
The pins to hold the saws must be tool steel—a number 10 knitting needle is good. It must be bent hot to the shape of a screw eye, about $\frac{1}{4}$ in.



hole and the straight ends $\frac{1}{2}$ in. long. These pins will want a little filing to fit $\frac{1}{8}$-in. holes.

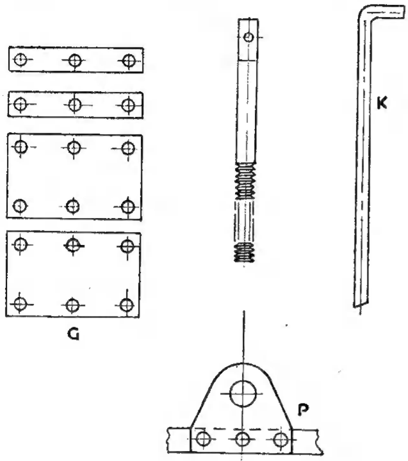
The hinge *P* consists of two M.S. plates $\frac{1}{8}$ in. thick. These are $1\frac{1}{2}$ in. long by $1\frac{1}{2}$ in. wide, drilled, reamed $\frac{5}{16}$ in., and held in place by three $\frac{1}{8}$-in. steel rivets. The outer ends are rounded and cut away as shown. It is best to sweat the two plates together before starting to work on them. The $\frac{1}{8}$-in. holes are, of course, $\frac{1}{4}$ in. from the inside edge and spaced $\frac{9}{16}$ in. A good job must be made of this part, as it has to stand a racking action. The best way is to drill the centre $\frac{1}{8}$-in. hole and $\frac{5}{16}$ in. through both plates then to unsweat them. When one plate is finished, drill the centre hole on the saw frame, bolt in place, and point the other two with the hand drill. After these are drilled $\frac{1}{8}$ in., re-assemble with one $\frac{1}{8}$-in. bolt, and the $\frac{5}{16}$-in. bolt, then drill by hand through the under plate. This will ensure alignment. Tight fitting steel rivets must be used.

The slide *G* consists of two pieces of $\frac{1}{2}$ in. square M.S. $3\frac{1}{8}$ in. long and top and bottom covers $3\frac{1}{8}$ in. × $1\frac{1}{2}$ in. × $\frac{1}{8}$ in. M.S. These are squared up and drilled $\frac{3}{16}$ in. The centres are



$1\frac{5}{16}$ in. long side, and 1 in. the short side. Do not drill these with clearance, but $\frac{3}{16}$ in. dead. These four parts are held against the lever arm with the saw frame in place. They should be found to just lie across as shown in the front view of drawing, when the saw is about horizontal. Do not mark the holes off on the lever until the saw frame is tried at each end of its stroke. It must give the same clearance at both ends. A small clamp, or better still, two, can be used to hold slide in place. When sure of its location, scribe the two centre holes, and drill and tap them $\frac{3}{16}$-in. Whit. Re-erect the job in

place, and if correct, drill and tap the other four holes. It must be noted that the fit here is very important. If slacker than 2 or 3 thous., the saw will chatter when in use, and a little play can be taken up by very slightly filing the holes with a $\frac{3}{16}$-in. file. Two 4 thou. copper shims can be placed under the top cover, as side play can be allowed. The surest way to make a good fit of



these parts is to put the lever in the vice, clamp all in place, and point all the holes well in with a $\frac{3}{16}$-in. drill in the hand brace. It is well to mention that all parts should be numbered with the steel stamps, also the bearing parts. When all these parts are erected, the machine should turn easily by hand. When the lever is let down the saw should be parallel with the bed. If not, the lever must be slightly set until it is so.

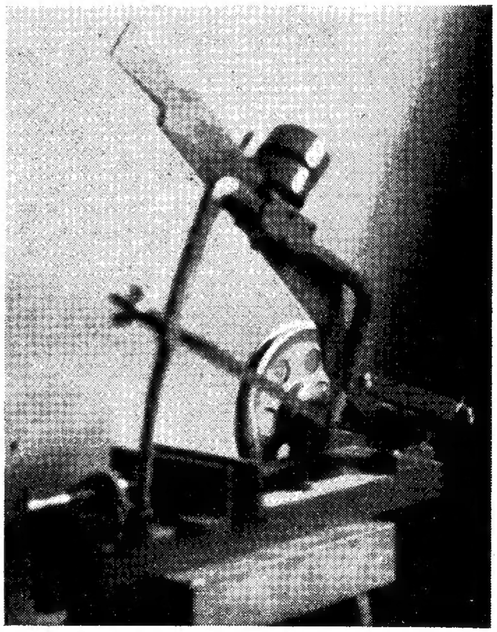
The vice consists of a fixed jaw *F* and sliding jaw *M*. Both are 2 in. × 2 in. × $\frac{1}{4}$ in. angle-iron $5\frac{1}{2}$ in. long. They have two M.S. jaws of $\frac{3}{4}$ in. × $\frac{1}{8}$ in. M.S. screwed to them by, in all, eight $\frac{3}{16}$-in. C.S. screws, $\frac{3}{8}$ in. long. The heads are well sunk and the jaws are criss-crossed with cold chisel cuts about $\frac{1}{8}$ in. spacing, and case-hardened. The fixed jaw is bolted to the bed by two $\frac{5}{16}$-in. bolts. The movable jaw is cut at the bottom to $1\frac{1}{4}$ in. wide. These will overhang the bed at the saw side, about $\frac{3}{8}$ in. Before being drilled they are put in place and the machine rotated to see that all is clear. The distance from the fixed jaw to the shaft centre will be somewhere near $11\frac{5}{8}$ in., and the movable jaw is set to open $3\frac{1}{8}$ in. Holes in the bed are marked off, drilled, and two slots cut to allow the one jaw to slide easily. These slots can be drilled, and cut with a hacksaw, or drilled, say, 9/32 in. every $\frac{5}{16}$ in., cut with keen chisel and filed up true. The movable jaw is held in place by two $\frac{5}{16}$-in. bolts. It is nutted and lock-nutted, so as to slide nicely.

The vice-screw is a $\frac{1}{2}$-in. Whit. set-screw, 6 in. long (or a bolt screwed all the way). Its head is turned circular, and it is drilled to take a $\frac{1}{4}$-in. loose handle 3 in. long. The head and nut of this are turned circular. This screws into an angle-bracket which is made of angle-iron 2 in. × 2 in. × $\frac{1}{4}$ in. × $4\frac{1}{2}$ in. long. It carries the vice screw at $1\frac{1}{2}$ in. height. Its foot is cut 1 in. wide; it is held on the bed with $\frac{5}{16}$-in. bolts. The place where the screw enters is reinforced by means of a $1\frac{1}{4}$ in. dia. × $\frac{1}{4}$ in. disc riveted on by two $\frac{1}{8}$-in. rivets. The corners are rounded away for appearance sake. Care must be taken to tap this $\frac{1}{2}$-in. hole quite square, or it will look very bad. Several applications of the square are called for.

The quadrant *N* is $\frac{1}{2}$-in. M.S. rod, 16 in. long. It is screwed 1 in. one end, and bent to the segment of a circle; the inside radius will be about $16\frac{1}{2}$ in., but measure your own machine. The curve can be marked out on a piece of wood or card (a lath, nail and pencil if no large compasses are to be had). The rod is chalked every in. and bent in the vice until it fits the marked template. This quadrant is held in place by two $\frac{1}{2}$-in. lock-nuts. It lies against the lever so as to steady it. The bottom end goes through a piece of 1 in. × $\frac{1}{4}$ in. M.S. 6 in. long. This sits on the angle bracket and is fastened down by the same bolts. Any excess end is cut off.

A M.S. clip made of $\frac{1}{2}$ in. × $\frac{1}{8}$ in. stuff is seen dotted at *H* in the drawing. It must not be tight, and is held on by two $\frac{3}{16}$-in. screws.

A trigger *K* is made of $\frac{1}{4}$ in. dia. M.S. It is 3 in. long, bent at right-angles $\frac{5}{8}$ in., and filed D shape underneath. It is held in place by means



Another view of the hacksaw machine

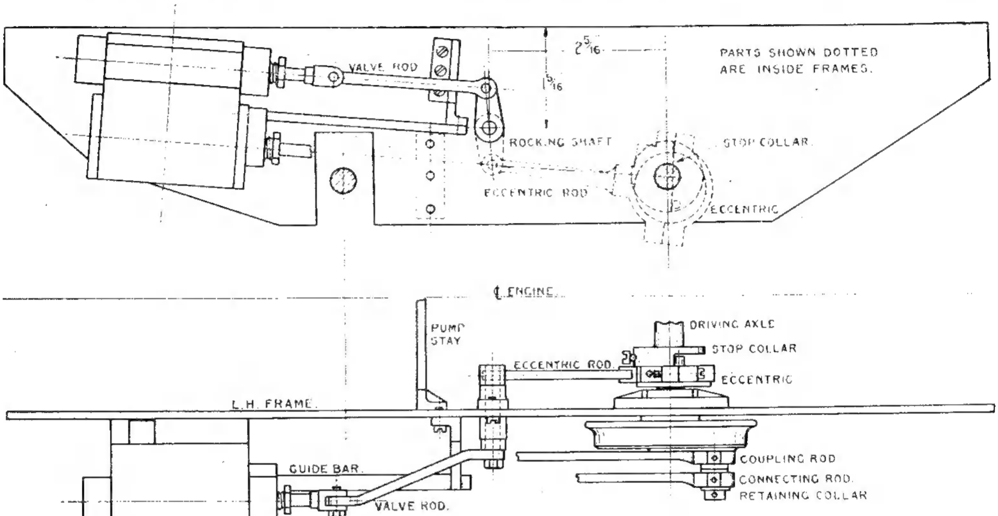
of two clips made of $\frac{3}{8}$ in. × $\frac{1}{16}$ in. M.S., also lightly held. It is held up to its work by means of a small coil spring. Its job is to keep the saw up when any work is being put in the vice. A notch is filed in the quadrant at *L*. These two small clips sit on two $\frac{1}{8}$-in. plates, so as to allow the spring free movement. $\frac{3}{16}$-in. or smaller B.A.

(*Continued on page* 235)

"L.B.S.C.'s" Beginners' Corner

Valve-Gears for "Tich"

As mentioned some time ago, I propose to give alternative valve-gear for "Tich"; the simple loose-eccentric, and the full Walschaerts. As the little engine will run around a circular track of suitable dimensions for any suburban back garden, there is no need for constant reversing; and for this, the loose-eccentric gear is the most desirable for locomotives made by inexperienced workers. It is easily made, easily set, and half-way between the axles, a rocking shaft works in a substantial bronze bearing attached to the frame by an oval flange. This carries two arms or levers. The outside one points upwards, and is made like a crank, the pin of which is connected to the valve-spindle fork by an offset valve-rod. The offset is unavoidable, because the crank arm must be set close enough to the frames to allow the coupling-rod to clear it, which it does by



Loose eccentric valve-gear for "Tich"

easily understood by the veriest Billy Muggins; the working parts are cut to the minimum, and there is nothing to go wrong. With the valves set as I shall specify, steam consumption is very low, yet the power and acceleration are all-present-and-correct-sergeant. Even on a straight up-and-down line, the slight push needed to reverse the engine—half-a-turn of a 2-in. wheel—is nothing to fret about. Still, I fully realise that there are lots of more experienced workers who are building the little engine as a "break" from bigger and more complicated types, and prefer a gear which can be reversed from the footplate, and notched up on a non-stop run; and so the description of the Walschaerts gear will fill their needs. I might add, for beginners' benefit, that the Walschaerts gear can be substituted for the loose-eccentric, at any time during the lifetime of the engine; and some beginners might care to fit the loose-eccentric gear for a kick-off, and change over at some later date, when they have had more experience.

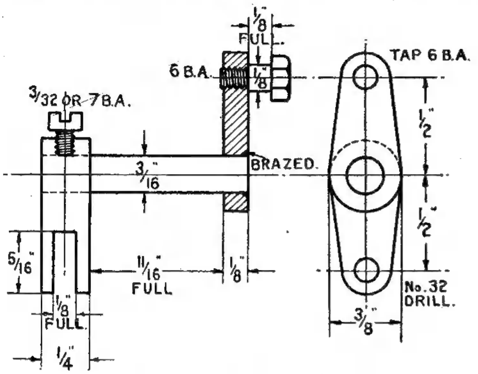
The accompanying illustrations show the layout of the gear. Mid-way between the centre-lines of the piston-rod and valve spindle, and almost 1/32 in. The centre-lines of the valve spindles could, of course, be brought into line with the rocker arm, and a straight valve-rod used, by adopting the Great Western type of cylinder; but if this were done, special patterns would be needed, and the cylinders could not be used for Walschaerts gear. However, offset valve-rods make no difference to the working of the engine; and as they are used in some types of full-size locomotives, nobody need lose any sleep through worrying about them.

The inside arm of the rocking shaft hangs downwards, and is slotted to take the end of the eccentric-rod. The eccentric itself is mounted on the driving axle, close to the hornblock, and is not fixed to it in any way (hence the term "loose-eccentric"), but is driven by the shoulder of the stop-collar catching against the pin in the side of the eccentric. This is the *only* type of valve-gear that gives equal port openings at both ends of the cylinders in either direction of running. Now to construction.

Rocking Shaft and Bearing

First of all, mark out and drill the holes for the

rocking shaft bearings. Scribe a vertical line on each frame, $2\frac{5}{16}$ in. ahead of the centre-line of the driving axle, using your try-square, with the stock resting against the top edge of the frame. If you have difficulty in measuring from the driving axle centre, take the distance from the extreme end of the frame, at the point where it touches the back buffer beam. This comes out at $6\frac{9}{16}$ in. On this line, at $1\frac{5}{16}$ in. from the top

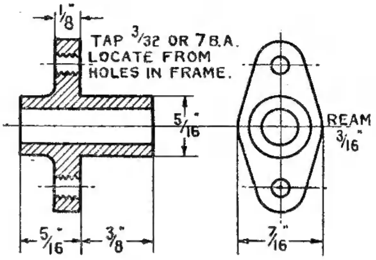


Rocking shaft and levers

of the frame, make a centre-pop, and drill it first with a $\frac{1}{8}$-in. drill, then open out with $\frac{5}{16}$-in. drill. File off any burr. On the vertical line, at $\frac{5}{16}$ in. above and below the centre of the hole, drill two holes with No. 41 drill, for the fixing screws.

Our approved advertisers will probably supply little castings for the bearings. Chuck by the shorter end, holding in three-jaw; if the other end doesn't run truly, a gentle tap with a hammer, with the chuck jaws slightly slack, will teach it better manners. Tighten the chuck jaws, and turn down the longer end to $\frac{5}{16}$ in. diameter for a full $\frac{3}{8}$ in. length, using a knife tool, and facing the oval flange at the same time. Face off the end, to bring the distance from flange to end, exactly $\frac{3}{8}$ in.; then centre, drill right through with No. 14 drill, and put a $\frac{3}{16}$-in. parallel reamer through. If you don't possess a $\frac{3}{16}$-in. parallel reamer, an excellent substitute for the job in hand can easily be made. Get a piece of $\frac{3}{16}$-in. round silver-steel, say about 3 in. long, and file off one end on the slant, like the old-time provision merchant, or the cooked meat vendor sliced a fat German sausage. Harden and temper the end; give the oval face a rub on the oilstone, and use it in the tailstock chuck, same way as I have described for ordinary reaming. This gadget will leave a true hole which will be an exact fit for the rocking-shaft spindle. Then reverse the casting in the chuck, and turn down the outer end, as shown, to approximately the same diameter, leaving the flange about $\frac{1}{8}$ in. thick. Note the distance from the *inner* side of the flange must be $\frac{5}{16}$ in., bringing the overall length to $\frac{11}{16}$ in.

If, by any chance, a casting should not be available, a piece of $\frac{7}{8}$-in. round rod, bronze or gunmetal for preference, can be used. Chuck it in three-jaw, face the end, centre, and drill to about $\frac{3}{4}$ in. depth with No. 14 drill. Turn down $\frac{3}{8}$ in. length to $\frac{5}{16}$ in. diameter, and part off at $\frac{11}{16}$ in. from the end. Reverse in chuck, and turn enough away to leave a flange about $\frac{1}{8}$ in. thick; then put the $\frac{3}{16}$-in. reamer through. File the flange oval, and you have the same result as if using a casting. Poke the $\frac{3}{8}$-in. end through the hole in the frame, from the inside; hold the flange tightly to the frame, so that it is vertical. Put the No. 41 drill through the screwholes, making countersinks on the flange. Remove, drill No.



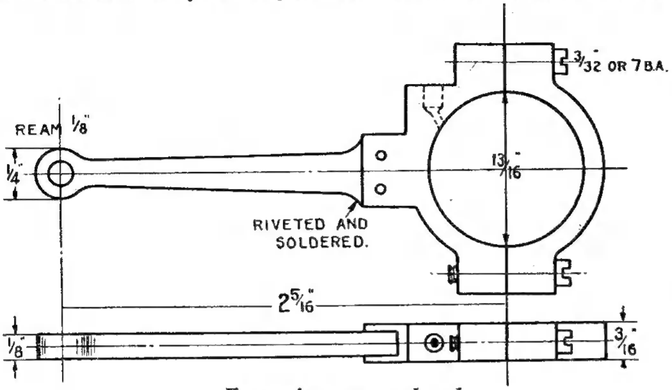
Rocking shaft bearing

48, tap 3/32 in. or 7 B.A., replace, and secure by screws (any shaped head you fancy) running through the clearing holes in frame, into the tapped holes in the flange.

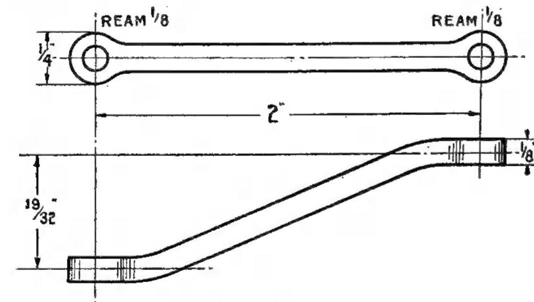
The rocker spindles are merely pieces of $\frac{3}{16}$-in. round silver-steel $1\frac{1}{8}$ in. long. The outside arm, or crank, is filed up from a piece of $\frac{1}{8}$-in. flat steel $\frac{3}{8}$ in. wide. To prevent what the kiddies would call "wobblisation," the holes must go through dead square; so mark them off at the end of a piece of rod long enough to hold in your hand while drilling the holes either on a drilling-machine or in the lathe, by the methods previously described. The big hole is drilled No. 14; the smaller one drilled No. 44, and tapped 6 B.A. Saw off the drilled and tapped piece, and file to the shape shown; then squeeze the spindle into it, by the same method as you squeezed the crankpins into the wheels. If the spindle really is a squeeze fit, it will not shift under ordinary working stresses; but if the fit is doubtful, the arm can easily be brazed or silver-soldered to the spindle, as shown in the sectional illustration. A small blowlamp or air-gas blowpipe, supplies plenty of heat for these small jobs, and a suitable brazing-pan can be made from a small tin lid filled with coke or asbestos cubes. When at my old home at Norbury I used a discarded metal soap-dish. The hole should be countersunk on the outside of the arm, and the spindle should project about 1/32 in. Cover the place with some wet flux, such as Boron compo mixed to a paste with water; blow up to bright red, and touch the joint with a bit of thin soft brass wire, which will melt and fill up the countersink. Silver-solder may be used, in which case only a dull red heat will be needed. Let cool to black, quench in cold water, file the projecting bit of spindle flush with the face of the arm, and clean and polish up the whole doings with a strip of fine emery-cloth. The arm should then be "shift-proof,"

and the outside perfectly smooth, a brass ring showing the location of the filled-up countersink.

The inner arm is adjustable, for valve-setting purposes. It is made from a piece of $\frac{3}{8}$-in. by $\frac{1}{4}$-in. mild-steel, and is marked out similarly to the outside arm. Drill the small hole No. 32, and the larger one No. 14 as before; then make use of one lesson already learned, and slot the end of the rod to a depth of $\frac{5}{16}$ in., by the same process as described for slotting the end of the pump ram. We are now approaching the stage when you can start to realise that "experience teaches," even if the experience is only a few weeks old! Saw off the piece, file to shape, and drill a No. 48 hole in the end as shown, tapping for a 3/32-in. or 7-B.A. set-screw. Put the shafts through the bearings, and put the inner arm on temporarily; see that the shaft rocks easily. The spindle should fit the bearing exactly, but without shake. A small oil-hole may be drilled in the bearing, if desired, close to the frame.



Eccentric strap and rod



Valve-rod

Eccentric-strap and Rod

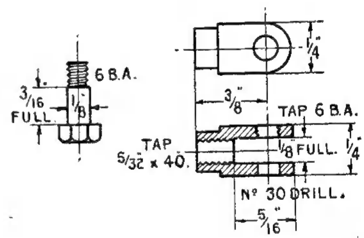
Here again, you can draw on your newly-acquired experience, for the method of machining up the eccentric-strap, and making the rod and fitting it, is exactly the same as described for the eccentric-strap and rod used for the pump. The only difference in personal appearance is that this one has the joint between the two halves of the strap, at top and bottom, instead of being on the slant. To repeat very briefly the sequence of operations, first clean the castings up (that is, if they need it; some are clean enough without needing any filing at all), drill the lugs, saw across, screw the parts together again, chuck in four-jaw, face one side, bore, face other side, slot the lug for the rod, make and fit the rod, and drill and ream the eye. This can be case-hardened, or bronze-bushed, just as preferred. Distance between centres of strap and eye is $2\frac{5}{16}$ in.

Take off the inner rocking arm; place the eve of the eccentric-rod in the slot, slightly taper the end of a piece of $\frac{1}{8}$-in. silver-steel, drive it through the lot, cut off and file flush each end. Then put the eccentric-straps on the loose tumblers, same as mounting the pump eccentric-strap, and at the same time replace the arms on the end of the rocker spindles. That completes the work inside the frames.

Valve-rod and Fork

In the drawings of the cylinders, a wide-jawed valve fork or crosshead was shown, and a description of how to make it was added. The wide jaws not being needed for the loose-eccentric gear, a narrow-jawed fork is substituted, as shown in the accompanying illustration. It is made exactly as described for the other one, so I need not repeat the details. The material needed is a piece of $\frac{1}{4}$-in. square mild-steel rod. Before slotting, drill the cross hole with No. 44 drill; after slotting tap one side 6-B.A., and open out the other side with No. 30 drill, as shown.

To make the valve crosshead pin, chuck a piece of $\frac{3}{16}$-in. hexagon steel rod in three-jaw. Face the end and turn down $\frac{5}{16}$ in. length to



Valve spindle fork and pin

$\frac{1}{8}$ in. diameter; further reduce a bare $\frac{1}{8}$ in. to 7/64 in. diameter, and screw 6-B.A. Part off to leave a head 3/32 in. thick; reverse in chuck, and chamfer the corners of the hexagon. The pin for the outside arm of the rocking shaft is made in exactly the same way, except that the plain part is only a full $\frac{1}{8}$ in. long. An alternative way of making the pins, is to use $\frac{1}{8}$-in. round silver-steel, turning and screwing both ends and fitting a nut permanently to one end. Pins made thus are very long-wearing; the "natural"

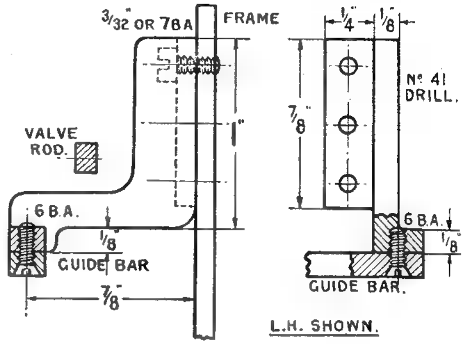
finish of silver-steel resists wear to a remarkable degree.

The valve-rod is made from $\frac{1}{4}$-in. by $\frac{1}{8}$-in. flat steel rod. Note that the distance between centres of eyes is 2 in. *after* the rod has been set over as shown ; so when you mark out the rod on the flat piece, set the distance between pinholes farther apart to allow for bending. The approximate distance " in the flat " is $2\frac{1}{8}$ in. There is no need to go to the refinement of " mike " measurements, because we have two means of adjustment, viz., the set-screwed inner arm of the rocking shaft, and the screwed spindle working in the tapped nut actuating the slide valve. The method of making the valve-rods is pretty much the same as making the coupling-rods ; they may either be milled or filed, as per the instructions given for coupling-rods. The eyes may be bronze-bushed, if you care to take the trouble, same as the coupling-rod, except that the bushes would be filed flush each side. They will run for a very long time before showing signs of wear, if merely reamed and left soft ; also they may be case-hardened, as previously described. When bending, merely grip the eye in the bench vice, putting a couple of pieces of soft metal between the rough steel jaws and the valve-rod. If your fingers aren't strong enough for the bending job, use a pair of pliers, but again put a bit of soft metal over the rod to prevent marking it. Just bend until the angle tallies with the full-size illustration shown, and you are literally " all set." Then all that remains is to connect one end of the valve-rod to the outside arm of the rocking shaft, and put the other end in the slot in the valve fork, securing them with the pins already made as given above. If the inner arm on the rocking shaft is set exactly opposite to the outer one, the set-screw tightened, and the set-screws in the stop-collars also tightened, the valve-gear should operate perfectly when the wheels are turned by hand in either direction.

Guide-bar Brackets

Before setting the valves, the outer ends of the guide-bars should be supported, and this is done by aid of a couple of small brackets, cast for preference, though they may be made from plate material. Cast brackets merely need cleaning up with a file. A true surface on the contact side of the flange by which the bracket is attached to the frame, can be obtained by laying a flat file on the bench and rubbing the flange on it ; simple, but exceedingly effective. It was young Curly's pet method of getting a true surface on the rubbing faces and port blocks of his little toy oscillating cylinders. The underside of the lug to which the guide-bar is attached must be exactly at right-angles to this ; and if you put the stock of your try-square against the trued-up back of the flange, the blade will soon show if the underside of the lug is true, or otherwise. Judicious use of a file will soon put it right, if it is out of square. The lug could also be end-milled very easily if the casting is clamped under the slide-rest tool-holder with the flange resting on the top of the slide. If you set the flange parallel with the lathe bed, the underside of the lug will be at right-angles to it ; and if run across an end-mill or slot-drill held in the three-jaw, the result will be O.K. in every way. Don't forget that one right-hand and one left-hand bracket will be required.

Erection of the bracket is very simple. First, pull out the piston-rod to its full extent by putting the crank on back dead centre ; the crosshead will then be at the extreme end of its movement and the guide-bar should be perfectly free in it. Stand the bracket on the end of the bar in the position shown in the illustration, and hold it there by aid of a toolmaker's cramp put over flange and frame. With a bent scriber put



Guide-bar bracket

through the screw-hole in the end of the bar, mark a little circle on the underside of the lug ; or if you don't mind taking the trouble, disconnect the little-end of the connecting-rod from the crosshead, drop the rod clear, and make a countersink on the lug by means of a No. 34 drill put through the hole in the bar. Remove the bracket, and if a circle has been scribed, centre-pop the middle of it, and drill it—or the countersink, as the case may be—with No. 44 drill. Tap 6 B.A., replace the bracket, and secure with a 6-B.A. countersunk screw ; also replace the connecting-rod, if it has been disconnected. Turn the wheels by hand to make sure everything is quite free ; stop with the crosshead as far away from the cylinder as it will go. Temporarily clamp the flange to the frame again ; run the No. 41 drill through the screw-holes in the flange, and make countersinks on the frame. Follow up with No. 48, drilling through frame, tap 3/32 in. or 7 B.A., put screws in, any heads you fancy, and the job is done.

A plate bracket can be built up by cutting out a piece of 3/32-in. steel to the shape shown, silver-soldering on a little brass block to form the lug, and attaching the bracket to the frame by a piece of $\frac{1}{4}$-in. by $\frac{1}{16}$-in. brass angle riveted to the bracket, and screwed to the frame as described above.

How to Set the Valves

Valve setting on this engine, with the loose-eccentric gear, is very similar to the method fully described just recently, for the " wee 'Dot' like Doris." The easiest way for beginners is to set by sight, so take off the steamchest covers. First see that the rocker arms are exactly opposite, and the set-screws in the inner arms tightened up, also the stop-collar set-screws. The collars may

be in any position for the kick-off. Turn the wheels by hand until the outer arm of the rocking shaft is in mid-travel; then adjust the valve spindle in the nut, until the valve is also in mid-travel, the lap extending an equal distance beyond the ports at each end. This can be set "by eye," the valve-fork pin being removed, to enable the fork to be turned. Replace pin, and turn the wheels by hand, noting if the ports open an equal amount at each end of the valve travel. If they don't, either make further adjustment on the nut and spindle, or on the inner rocker arm, whichever you like. Now slack the set-screws in the stop-collars, and put one of the main cranks on front dead centre; that is, with the piston-rod right home. Turn the stop-collar by hand in a forward direction until the valve goes as far as possible to the front end of the steamchest. Continue turning slowly, and watch the valve carefully as it starts on its return journey. As soon as it starts to uncover the port, shown by a black line appearing at the lap of the valve, tighten up the set-screw.

Now turn the wheels by hand in a forward direction, and watch the valve. Note the position of the crankpin when the black line appears at the other end of the valve. If the crank is exactly on back dead centre, the valve is set correctly, and the length is right. If the black line doesn't appear until the crank has passed dead centre, the valve is too long, and a shade must be filed off *both* laps to keep the exhaust cavity in the middle. If the line appears before the crank reaches dead centre, the valve is too short, and beginners had best make another valve; but this is not likely to occur if the instructions have been followed.

Having got that right, turn the wheels backwards, so that the other end of the shoulder of the stop-collar drives the eccentric. If the black line of the port shows at each dead centre position of the cranks, the setting is O.K. If it shows *before* dead centres, the shoulder needs a little taking off it; a small chisel will do the needful. If the line shows after the crank passes dead centres, the shoulder needs making up a bit; and a small bit of brass soldered to it at the place where it catches the eccentric-pin is all that is necessary. When both ports "crack," as the enginemen would say, on each dead centre in both directions of movement, the valve setting is as near perfect as is possible to get; and the steamchest covers can be fixed "for keeps" with the joint washers or gaskets between the contact surfaces, as detailed out in the instructions for assembling the cylinders. Next, the Walschaerts gear.

A Belt-Driven Hacksaw Machine

(*Continued from page* 230)

screws can be used to hold the clips. A pin through the trigger takes the spring pressure. Two weights *W* are cast in lead, about 2½ in. dia., one 1½ in. thick, and the other 1 in. thick. These can be cast in a piece of sheet iron bent circular around a piece of pipe, and lightly riveted, the inside heads almost filed away. They are put in the self-centring chuck, skimmed up and drilled $\frac{7}{16}$ in. The weight bar to carry the weights is 5 in. long made of ⅜-in. M.S. It is forged out to ½ in. wide and drilled to fit on the lower slide screws. The slide screws are nutted on the off-side. Four of these will be 1⅛ in. long, and two 1½ in. The stop stud *O* is about 3½ in. long. It is ⅜-in. M.S. and screwed about 1½ in. to allow for adjustment. It holds the lever as soon as the saw has cut to the bed level. Care must be taken to put it in so that the bottom nut clears the angle-bed. The hole can be slotted.

Cycle lubricators (such as spring lid) are screwed into the two bearings, the angle-piece and big-end and an oil hole is drilled into the small-end. These lubricators are sold ¼ in. and $\frac{3}{16}$ in. cycle thread, but most workers will not stock those taps. However, No. 0 and 2 B.A. will fit these well if the dies are run over the cycle threads. They are a very near fit, so near that the lubricators can be held in a thin adjustable spanner whilst being re-screwed.

Conclusion

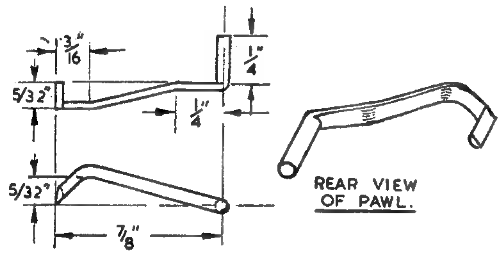
Remember, a speed of 50, and no faster. These saws last very much longer than in the hand saw, with no breakages. Do not tighten the saw blade too much, or the frame will spring and cause a stiff machine. Set the teeth towards the driving end. Use no weight for small stuff, a thin tube and one weight for thicker, and both for thick stuff. Enamel all except polished parts to suit taste. The machine is bolted or screwed to the bench with ¼-in. bolts. Four distant-pieces are turned $\frac{5}{16}$ in. bore about 1¼ in. long (or to suit your angle-iron) ¾ in. dia. These go between the bed and the bench on the ¼-in. bolts, and prevent the bed being distorted when the bolts are tightened up. The movable vice jaw should be moved right up to the job to be sawn by hand, then the screw tightened. The writer can lend the three patterns, and answer any points that are not clear, if desired.

*A Battery-Driven Electric Clock

by C. R. Jones

THE operating pawl was made from 1/16-in. diameter silver-steel to the form shown, the 1/4 in. long circular end working in the bearing of the adjustable lever, previously described.

In order to get a sharp corner at the angle of this portion, the wire was bent to a right angle and the angle heated up, placed in a 1/16 in. diameter hole which had been drilled in a piece of mild-steel, and hammered down with a light hammer. The other end was treated in a like manner, and the wire was flattened slightly the whole way between the two ends.



OPERATING PAWL.

The 5/32 in. end was filed off flat to a slight angle from the vertical, and this part operates the teeth of the count wheel. The operating pawl was polished all over, and the short end was hardened and tempered.

The part of the 1/4 in. end that protruded through the bearing in the adjustable lever, had a small tight fitting brass collar pressed on to retain the operating pawl in position.

The Dial

The dial was made from 16-gauge sheet brass, which was first flattened, and was securely screwed to a piece of hardwood fixed to the faceplate and faced up true.

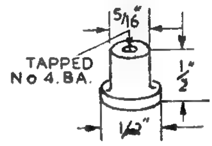
A light facing cut was taken over the brass blank, and the circles shown on the drawing, cut a good 1/64 in. deep with a specially ground parting tool. The minute spaces were then cut with a parting tool on its side, and using a 60-tooth change-wheel for divisions. The faceplate was then removed and the Roman numerals carefully and clearly marked out.

The faceplate having been refitted to the lathe, the short curved lines at top and bottom of numerals were deeply cut with a narrow parting tool, as these gave the tool a start and finish on the next operation. Using a tool of correct width, the units which were radii were cut by means of the topslide.

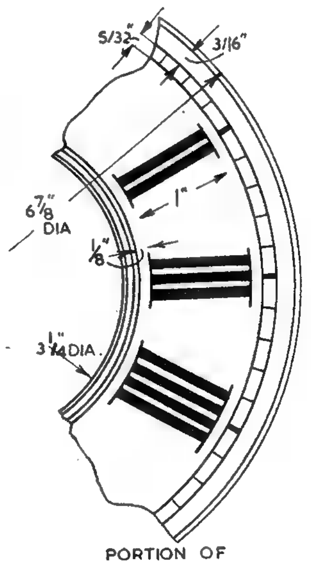
These were "1," the middle unit of "3," and the third unit of "8." For the other units which are parallel, the tool was packed up or down, as the case may be, *only* shifting the dividing gear at each *hour*.

The fives and tens were scraped in (the term engraved cannot be used) with the faceplate removed from the lathe. It was replaced on the lathe, and the dial polished, the dial ring being then parted off to the correct size.

The three dial mountings were then turned up to the sizes shown, and these were fixed to the front plate of wheelwork by means of No. 4-B.A. set-screws passing through the No. 27 holes.



DIAL MOUNTINGS. 3 OFF.



PORTION OF DIAL.

The dial was set up in the lathe, held in the chuck by the hole in centre, with the back of the dial facing the tailstock, and the three dial mountings affixed to the front plate were brought up against the back of dial, with the tailstock centre entering the centre spindle hole. A line had been previously scribed on back of dial dead

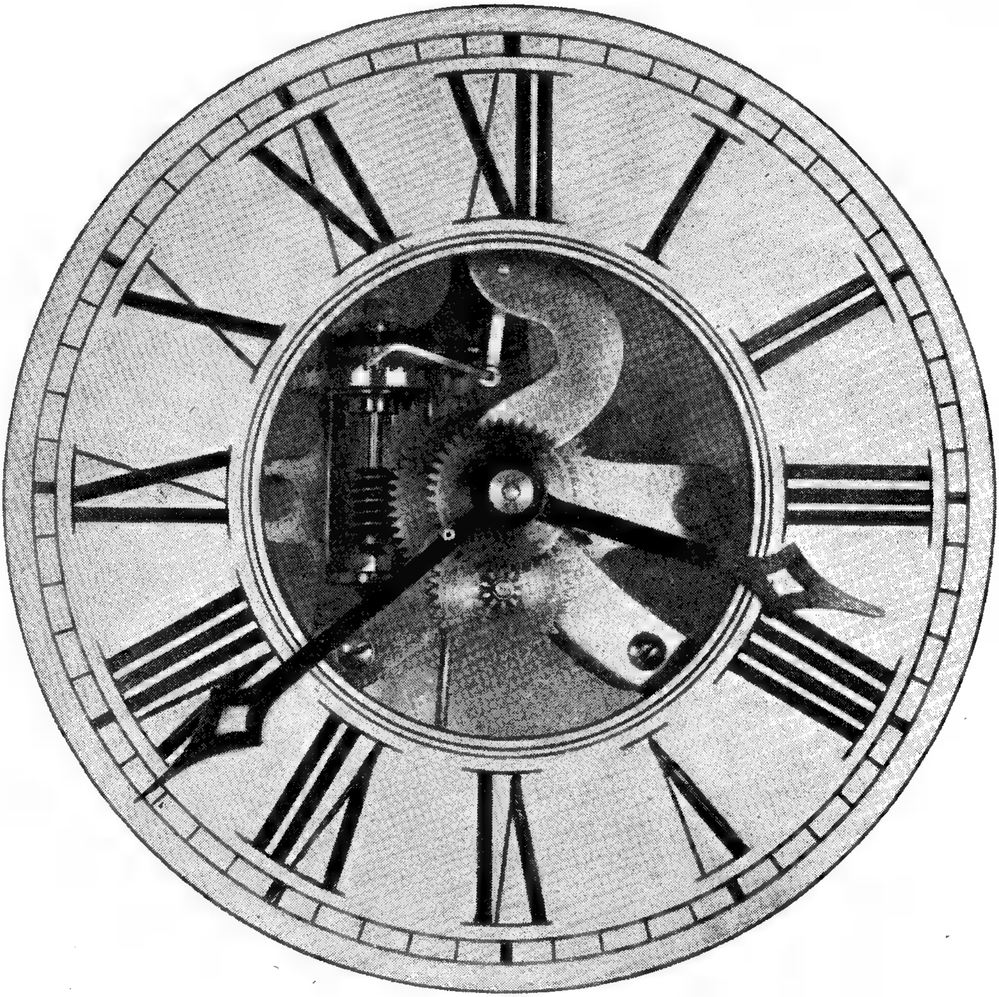
*Concluded from page 206, "M.E.," February 16, 1950.

in line with the centre of twelve o'clock, so that the front plate could be lined up with the dial.

The positions of the dial mountings were then scribed round where they contacted dial, after which the dial was removed, and the dial mountings sweated to it in their correct positions.

The dial was again polished and the figures were filled in with black cellulose, after which made into a paste with about double its bulk of cream of tartar.

The dial which had been finally polished, was thoroughly washed in clean water, and the mixture rubbed on with a piece of clean cloth. After which the dial was again washed in clean water and dried, polished with a soft clean cloth, and sprayed over with a thin coat of clear cellulose.



The dial and wheelwork

it was silvered. The silvering was carried out as follows, and the amounts are correct as far as the writer can remember :—

A few crystals of silver nitrate (about as much as would go on a sixpence) were dissolved in 2 oz. of water, and two heaped teaspoonfuls of common salt were dissolved in 4 oz. of water. The salt solution was then poured into the nitrate solution, and the precipitate allowed to settle. This was then washed by draining and pouring on several lots of clean water leaving it to settle in between. The precipitate was then

The silvering was successful, and looks quite a professional job.

Assembly

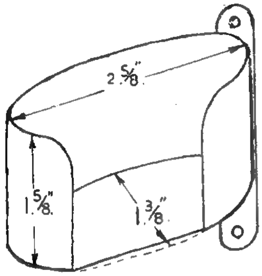
When the plates and the various parts of the wheelwork had been finished, the centre wheel and its spindle were fitted in position, and the count wheel assembly and bracket placed in the working position, with the worm properly meshing with the centre wheel. The slots in the rear plate were then marked off on to the back of the count wheel bracket, and tapping

sized holes for No. 4 B.A. were drilled in the bracket.

These holes were then tapped No. 4 B.A., and the bracket was then fixed in position with suitable set-screws and washers.

The crutch spindle was now inserted through the hole $\frac{1}{4}$ in. in diameter in rear plate, and its bracket clamped in the correct position. The holes were then marked off in the rear plate and drilled and tapped No. 5 B.A. The bracket was then secured with suitable set-screws.

Nothing has been said so far of the 1-12 gears for working the hour hand, but a set of gears were found which would have been suitable for



BATTERY HOLDER.

size, but which were considered too light to match the other parts of the clock, so they were copied, fly-cutters being made to the same tooth form, and new wheels made in $\frac{1}{16}$-in. brass. The pinions were used again, and the pinion on the centre spindle and shown on the drawing, was broached to be a good driving fit on the spindle. The end of the centre spindle was slightly tapered to take the minute hand collet.

The wheel which meshes with the pinion on the centre spindle had the pinion shouldered and riveted in its centre, and was reamed to fit ■ pin 3/32 in. in diameter which was shouldered down at its lower end to 5/64 in. diameter, and riveted in the front plate in the position to give correct meshing of teeth.

This wheel was held in position by means of ■ spring wire circlip, sprung into a shallow groove in outward end of spindle.

Two $\frac{1}{4}$ in. diameter steel studs were made as shown on the main frame drawing, and these were screwed in the main frame in the two holes shown at $3\frac{1}{8}$ in. centres. They were furnished with a hexagon nut at each end, and the $\frac{3}{8}$ in. threaded ends were screwed into the frame flush with the underside and locked into position by means of the nuts. The nuts at the outer ends were adjusted until they measured about $2\frac{1}{8}$ in. from front surface of baseboard. This arrangement enables the wheelwork and dial unit to be easily fitted or removed, as the two $\frac{1}{4}$-in. holes in the rear plate slip on to these studs and are held in position by means of the two brass cap nuts also shown.

The cap nuts enable a certain amount of adjustment to be carried out.

Two brass collets were made for the hands, which were made from ■ piece of thin clock spring and the collets were riveted in. The minute hand collet was made of a length to retain the hour hand wheel in position.

While the clock was under construction, efforts were made to obtain some well seasoned wood for a proper baseboard and the case, and eventually an old dressing table made of walnut was obtained at ■ sale for a very small amount, and this supplied the necessary material.

The baseboard is shown on the drawings, and is 2 ft 6 in. in length by $7\frac{1}{2}$ in. wide, and has battens screwed and glued on to the back to stiffen it, not forgetting to make a groove in the centre batten, to accommodate the wires coming up from the magnets. The magnets were fixed to the new baseboard by means of $\frac{1}{4}$ in. diameter round-headed Whitworth set-screws, the nuts being sunk in recesses in the lower batten at the rear.

The works were remounted on the baseboard and ■ battery holder made from thin sheet brass, and soldered together. This battery-holder was fixed at the right side of the main frame as shown on the photograph, as there was just enough room to accommodate it.

The clock was now wired up properly to the same circuit as before, all the wiring being carried at the rear of the baseboard, with the exception of the battery connections which were made by means of short flexible leads furnished with small crocodile clips, as these enable the battery to be changed without stopping the clock.

The case was made up to the shape shown, and has no door, the whole case being lifted off when necessary, which is at very infrequent intervals.

The main frame was cellulosed black, also the magnet frame, the armature, the pendulum, and the battery holder.

The plates and wheelwork were well polished and given a thin coat of clear cellulose, and the hands were cellulosed black. The arc of the swing of the pendulum can be very accurately controlled by means of the trigger block, as if this is moved to the left the swing increases, and vice versa.

When the wheelwork was in position ■ certain amount of adjustment was necessary and was carried out by altering the length of the adjustable lever, which controls the movement of the operating pawl, but since this was once made satisfactory, nothing further in the adjustment line has been necessary.

The writer has found no trouble with the operating pawl picking up more, or less, than one tooth at a time.

With the clock driving the wheelwork, the period in between contacts is nearly two minutes with a good battery, and considerable improvement can be gained by experimenting with adjustments to the trigger block, and the adjustable contact.

The backstop pawl should operate centrally, with the straight side of one tooth against it, and the operating pawl should rest halfway between two teeth, with the pendulum at rest.

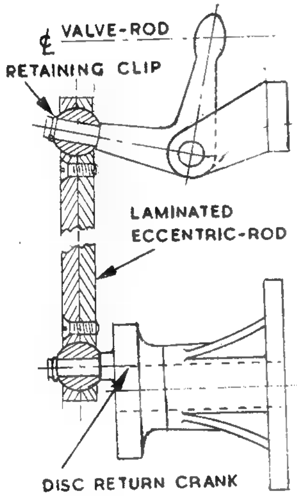
It will be noted that most of the adjustments have been placed so that they can be easily got at at the right, or from underneath, the writer being right-handed.

The clock has been going for a considerable while now, and keeps excellent time.

*UTILITY STEAM ENGINES

by Edgar T. Westbury

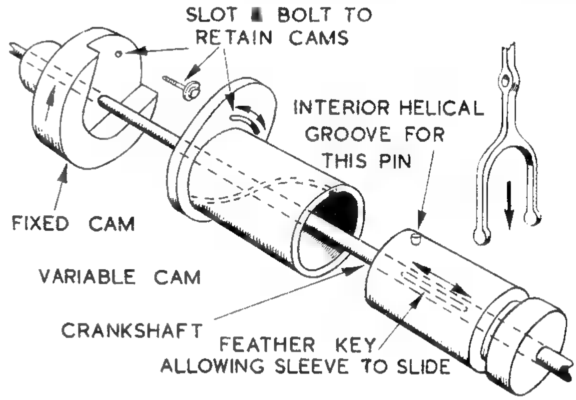
TO conclude this series of articles, I propose to deal with a number of comments and criticisms which have been received from readers. Before discussing specific points, however, I would like to call attention once again to the fact that the articles were never intended to constitute a complete treatise on model steam engines, as some readers seem to have assumed, but only to furnish information on certain aspects of their design, of practical use to the model engineer who wishes to apply them to utility purposes. I have never posed as an authority on the steam engine in any of its many forms, though I can claim a certain amount of professional experience with marine engines, in sizes varying from picket-boat to battleship. If the articles have helped to fill gaps by furnishing information which has not hitherto been available, or has been difficult to obtain, on the practical application of steam engines to models, such as power boats, they have served their designed purpose.



Modified valve driving gear for the "Humming Bird" engine based on Mr. Blackstaffe's suggestions

Such subjects as the design of various types of reversing gears, the technique of model boiler construction, and boiler fittings, which have formed the subject of many comments and queries, have not been included in this series, because they have been adequately and authoritatively dealt with on many occasions in the past, by other contributors to THE MODEL ENGINEER, and I do not consider that I could add much to knowledge already available concerning them. For the same reason, the more conventional types of steam engines, boilers and feed pumps have only been featured sufficiently to show typical examples, and more attention has been paid to types which are not so well known, but which I consider to be worth investigation from the aspect of utility or efficiency.

I cannot agree with the correspondent who suggests that it is futile to attempt to improve upon the conventional type of steam engine, adding that the design of reciprocating steam engines reached finality many years ago, and the fact that such high-efficiency experts as Abner Doble were content to use conventional principles of steam engine design ought to be good enough for me. The idea that anything in engineering ever reaches "finality" is either the height of complacency or sheer defeatism; and it is not borne out by facts if one considers closely the latest tendencies in full-size steam engine design, including marine, stationary and locomotive types. But even apart from the motive of actual *improvement*, departure from conventional forms of design is justified in model engineering, on the grounds of experimental interest and variety. While it is true that many changes can be rung on the design and arrangement of engines, without departing from strictly conventional lines of design, and that interest in them need never grow stale, a novel and original idea that works well is always an added attraction and often serves to re-awaken flagging enthusiasm among engine constructors.



A suggested variable cam device for poppet valve engines (from Mr. Bristow's rough sketches)

Several readers have asked for true-scale prototype designs, a request which has been carefully noted for future reference, although it is considered outside the scope of the present series. It should be remembered that a set of drawings for a fully detailed compound or triple-expansion marine engine (such as one reader says he has waited for "with growing impatience") represents a considerable amount

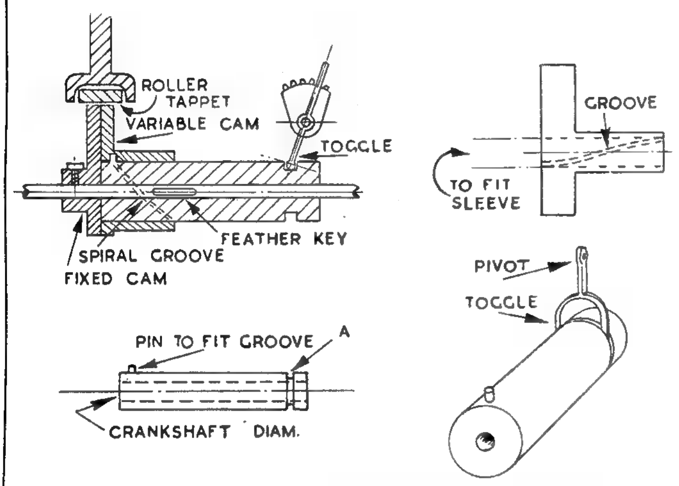
*Concluded from page 185, "M.E.," February 9, 1950.

of work which could only be justified if it were likely to interest a large number of readers ; and the success of the design would be dubious unless castings and supplies were available, which might be difficult to arrange in view of the initial cost of the many and complicated patterns.

A "Humming Bird" Criticism

Mr. C. Blackstaffe, of Victoria, British Columbia (who, incidentally, is the designer of the highly unorthodox crosshead-type two-stroke engine published in the issue dated October 27th last), has made some comments on the valve gear design of this engine, and as somewhat similar observations have been made on this subject, further reference to it is desirable.

The feature in question was not overlooked in the design, and I am fully aware that it is not an ideal mechanical arrangement, but it was found to work fairly well in actual practice. The sides of the eccentric strap, if closely confined by the cheeks of the sheave, so that no end play is allowed, form a thrust collar of fairly large area, which effectively prevents the tendency of the ball to slide endwise on the bell crank, to a further extent than is necessary to compensate for the arc of movement of the latter. It should be remembered that in this engine, which was adapted as a conversion from an i.c. engine design, the utmost simplicity was aimed at, and there are several features which admittedly could be cleaned up and improved by the intelligent constructor.



Further details of the suggested variable cam gear

I agree entirely with Mr. Blackstaffe's reasoning and his suggestions for modification. And in this connection, may I be allowed to observe that I have never regarded stereotyped finality as a desirable feature in a design intended for the amateur constructor ; at the risk of being accused of mere sophistry, or making a virtue of necessity, I assert that I always believe in leaving something to the intelligence of the reader. I emphatically agree with the opinions expressed by Mr. K. N. Harris, in the issue of THE MODEL ENGINEER dated January 19th, regarding the dangers of taking the soul out of model engineering, by reducing all instructions to the finality of a drill book. In these days, model engineering seems to be practically the last stronghold of the individualist ; let us renounce the false doctrine that teaches us that it is wrong to try to think for ourselves !

He states : "You have made a good attempt to overcome an admittedly awkward problem ; to wit, the universal coupling of the eccentric rod to the bell crank. The snag I see is that the ball is free to slide on the arm of the bell crank in order to keep the eccentric rod at an angle of 90 deg. to the crankshaft at all positions. The only guide for the eccentric rod is the eccentric strap, and at each end of the valve travel, when the angle of the bell crank is greatest, the push and pull of the eccentric will slide the ball along the bell crank, causing the excentric strap to bind, as the bell crank has a three-to-one leverage on the diameter of the eccentric.

"There are three alternatives to this arrangement : first, to fix the ball on the bell crank and use a partially-spherical eccentric sheave. This is made easier by the ingenious eccentric-rod made in two halves. Second, if no power take-off at that end of the crankshaft is needed, a crank disc and ball-shaped crankpin could be used, again in conjunction with the halved eccentric-rod ; this will reduce the friction of a high-speed eccentric. Third, the use of a bevel-geared vertical shaft with crank and banjo connecting-rod as in the Stuart-Turner 'Star' engine."

Now let me present the case for the defence.

I have made a sketch embodying the second of Mr. Blackstaffe's suggestions, which I consider to be the most suitable arrangement of the three in this particular case. It will be seen that the eccentric is replaced by a disc return crank (this will necessitate a slight shortening of the crankshaft at the valve gear end) on the crankpin of which is mounted a $\frac{1}{4}$-in. ball, drilled through the centre as described for the ball on the bell crank, and in fact identical to the latter. Note that it is not practicable to form this ball integral with the crankpin, unless the latter is detachable from the crank disc ; neither is it possible to make the upper ball integral with the bell crank lever, as in either case it would prevent the assembly of the inner half of the connecting rod, unless the latter is split on the axial plane of the balls. Neither of the balls need to have endwise movement, however, so they may be fitted fairly tightly on their pins, and retained from end movement by a circlip or a small nut. The sketch is not to exact scale, but is sufficiently accurate to demonstrate the principle ; all parts other than the disc crank and connecting rod are exactly the

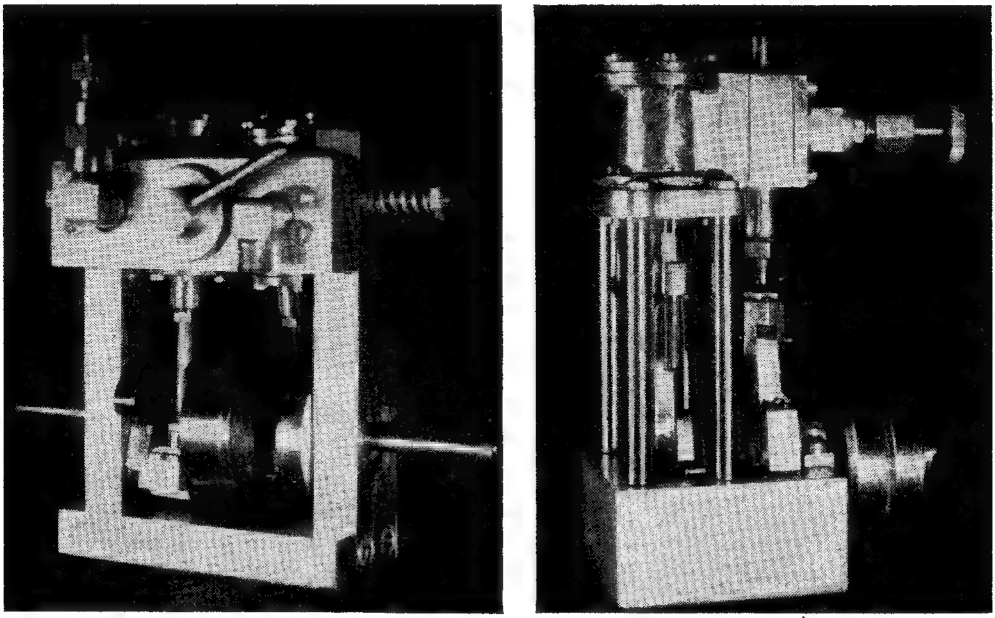
same as shown in the details of the " Humming Bird " engine.

Variable Cam Timing for Poppet Valves

Mr. H. Bristow, of Iver, Bucks, has sent me some suggestions, together with sketches and a cardboard model, of a proposed device for varying the opening period of a poppet valve by using a two-part cam, the main portion of which is fixed to the camshaft, but the subsidiary part is capable of being shifted to alter, in effect, the angular length of the cam lobe. The method of moving this part, while the engine is running, is by a sliding sleeve, feather-keyed to the shaft, and carrying an external pin or key which engages an internal spiral keyway in the boss of the subsidiary cam.

This is an interesting device, the mechanical principle of which has often been used for phase-shifting mechanism, and is not without precedent in cam-operated valve gears. An article on the D-49 class three-cylinder 4-4-0 locomotive of the North Eastern Region of British Railways, published in the issue of *The Railway Gazette* dated September 23rd last, contains drawings of the cam-operated valve gear in which several features of similarity to Mr. Bristow's idea are evident.

The application of the principle to small high-speed engines, however, is by no means as simple as it looks, and from experience with mechanism of this nature in the past, I should say that it would necessitate extremely accurate fitting, and in any case would be liable to heavy wear and tear. A well-known marine petrol-paraffin engine once used a spiral-spline device for advancing the phase of the magneto, but as a result of mechanical trouble encountered with it, reverted later to the orthodox method of shifting the contact-breaker cam ring. In a small flash steam engine, the added bulk and weight of the mechanism would be a deterrent to its use.



An all-fabricated twin oscillating engine, and a " Trojan " type double-acting slide-valve engine, built by Mr. A. G. Seels, of Seattle, U.S.A.

It may, moreover, be noted that marine steam engines, which do not have to start up against a heavy static load, neither need, nor obtain the same benefit, from running adjustment of valve timing as a locomotive or traction engine. Large marine engine valve gears are generally adjusted and timed to produce maximum economy at full gear, and are rarely " linked up " when running. The value of a device such as suggested by Mr. Bristow would be more likely to be realised in a purely experimental engine, in which systematic investigation of valve timing was undertaken. It certainly merits consideration from this aspect of design.

Steam Enthusiasts, Advance !

The majority of THE MODEL ENGINEER readers are devotees to the cause of the steam engine in one or other of its forms, and it may be that in offering the slightest breath of criticism regarding their opinions or activities, I am rushing in where angels fear to tread. But I have discussed steam engines with very many engineers, both amateur and professional, and have come to the conclusion that the besetting sin of the steam enthusiast is complacency—a fixed idea that the

orthodox steam engine is the best form of motive power, and that though other prime movers may outstrip it in respect of performance in relation to bulk and weight, or the attainment of high r.p.m., these engines are fuss machines, noisy, harsh and temperamental, and that to do a job of work, and keep on doing it, the steam engine is the only proposition. It is significant that in many of the conversations and letters, one phrase keeps on recurring—" There's nothing like steam ! "—a platitude which is as obviously self-evident as saying that there's nothing like leather, or old-and-mild, or suet dumplings, but can hardly be classed as technical logic. Several writers have become eulogistic " in praise of steam "—but I say, let us praise, not the steam, but the engineers, whether celebrities or nonentities, who have harnessed it, and are capable of developing it to still further heights of efficiency, if they will but put their minds—and equally important, their hands—to it.

As one who is just as enthusiastic about steam engines as about any other motive power or mechanism, let me exhort these idealists to descend from their castles in the air, and really get cracking on the development of the steam engine on modern lines, not scorning to utilise all that is known in other fields of engine design, from turbo-jets to diesels. That does not mean that we must forget the engines of the past, or the development of good engines on conventional lines (which are by no means as good as they can be yet), but that we should build on the solid foundation which these provide, so that in a future generation the statement " there's nothing like steam " will be, as now, tribute to its incomparable merit, and not mean that there is nothing like it in existence any longer !

I have been very sorry to see the decline of practical interest in flash steam development ; although there is no lack of theorising and argument around this subject, few model engineers seem to be willing to take the trouble to carry out practical experiments with it. Some years ago I belonged to a select circle of steam car enthusiasts who used to sit for hours debating, planning and indulging in beautiful pipe dreams of the ideal car—which, obviously, would have to be driven by steam. Many new and brilliant ideas were expounded—only the new ideas were not brilliant, and the brilliant ones were not new !—but none of these people had ever done a hand's turn towards the development of their cherished schemes. It is, apparently, one thing to worship steam engines from afar off, and another to give practical demonstrations of faith.

There are many model engineers who are content with steam engines as they are, and are happy in their construction, without thought of whether they are the be-all and end-all of efficiency. With these, I have no dispute whatever, but it is a very different matter when all sorts of claims are made about the relative superiority of such engines over all other forms of motive power, and I am always ready to join issue in this sort of argument. Again, one meets many people who wish to go ahead, but expect to find everything worked out for them. Development work of any kind is a job which calls for patience, initiative and determination, and one must expect many set-backs before success is achieved.

In these articles I have given many examples of individual, if not entirely original thought, which I consider worth while following up. All these ideas work, and are sufficiently efficient and successful to justify their recommendation, but they are by no means the last word that can be said in their particular line of development. Moreover, they are all capable of adaptation to diverse forms of design and arrangement.

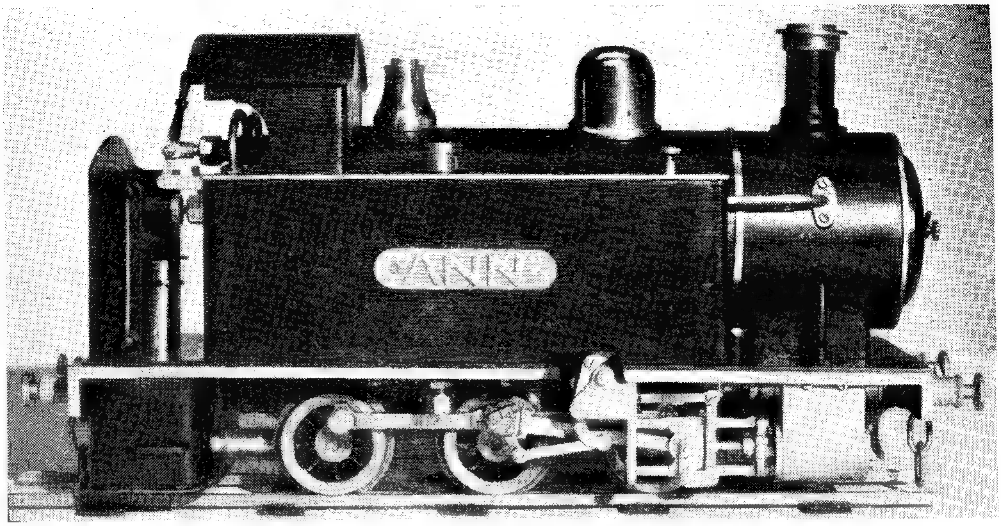
For instance, one reader " likes the ' Venturer ' engine, but wishes it had been a side-by-side instead of a flat twin." Well, there is no reason why the design could not be adapted in this way, and it is by no means difficult to do this, using exactly the same essential features in the cylinder design, but a different crankcase, with a two-throw crank, and a camshaft having four cams, spur gear driven in the original way. Note that the working parts become more complicated and difficult to machine—the question arises, does one obtain a corresponding advantage in the efficiency of the engine ?

Several readers have informed me that they are building the " Spartan " engine, but propose to use the modified form with a piston valve, " because they understand it better "—another instance of the reluctance of the steam engineer to give a new or unconventional feature a fair trial. The better principle would have been to make it with *both* forms of valve gear, and test out which gives the better results, taking care to use it under its most appropriate conditions in each case.

But no matter what type of engine you decide to build, whether it is made from a set design, or is a child of your own brain ; whatever purpose you use it for, and whether it is intended to produce high or low efficiency—you can still do your share to promote the cause of good craftsmanship, which is the most important thing of all, whether one is a novice or an expert, a lover of past engineering achievements, or a believer in future developments. But even good craftsmanship, important as it is, should not be regarded as the only worthwhile aim of model engineering. One need not always trail along in the wake of full-size practice ; it has been proved many times in the past that the model may be the father of the large engine, instead of its problem child. Experimental work and creative design are within the capacity of all model engineers, and apart from any material incentives which they may offer, are worth while for the added interest and pleasure which they contribute to a pastime which is already second-to-none in this respect.

Utility Steam Engine Castings

In reply to many enquiries regarding the availability of castings for engines described in this series of articles, I regret that some difficulties have arisen in making arrangements with trade suppliers, but these will be rectified as soon as possible. Castings for the " Trojan " engine are supplied by Craftsmanship Models Ltd., and for the " Warrior " engine by the Imperia Co., as already announced. I hope to be able to inform readers that castings for other engines will be available in the near future.



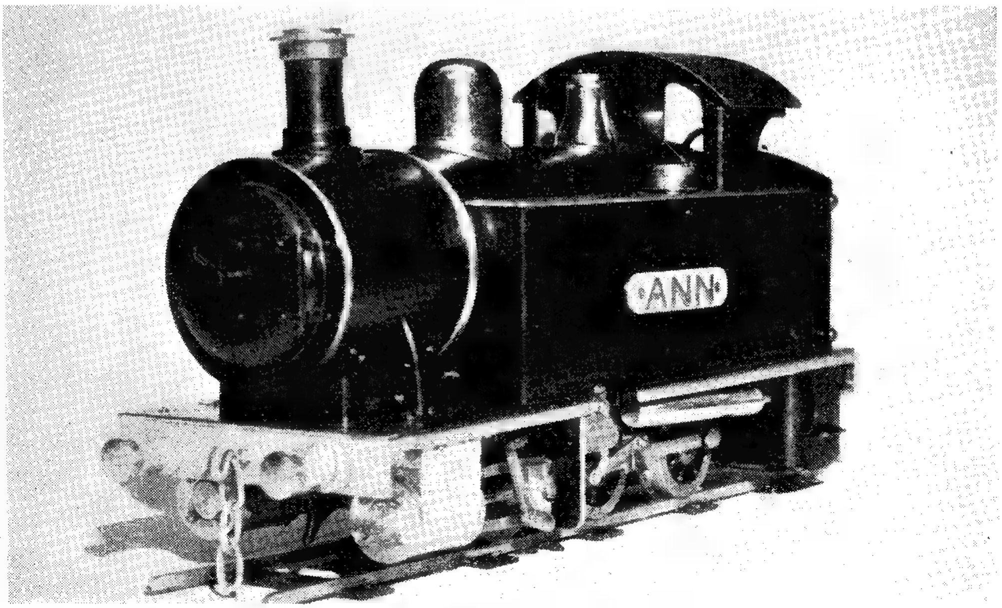
An "O" Gauge Steam Loco

THE little locomotive illustrated was inspired by an " L.B.S.C." design published in THE MODEL ENGINEER a number of years ago. Although " Ann " runs on an " O " gauge track, being a narrow gauge shunting engine, the scale would work out at $\frac{3}{8}$ in. The layout of the Baker gear fitted also came from the able pen of our famous contributor.

Brief details are $\frac{3}{8}$ in. × $\frac{5}{8}$ in. cylinders, wheels $1\frac{1}{8}$ in. diameter over tread. Spirit-fired water-tube boiler. Fully sprung axles. Pole lever with spring tensioner is used for reversing which can also be " notched up."

Running is usually done out of doors and by the aid of a quick-filling chute on the bunker for spirit, and a portable hand-pump having a rapid-coupling hose to a connection on the back of the bunker, the little engine can be kept in steam for as long as may be required.

The displacement lubricator situated in the side o/s tank also is designed with a view to quick filling " out of the bottle," a good means of testing the steadiness (or otherwise) of the engineman's hand.—MARTIN W. MCGRATH



IN THE WORKSHOP

by "Duplex"

*57—Workshop Drawings

ONE further process must be learnt before it is possible faithfully to portray an engineering component, and that is the method by which hexagons, and more particularly nuts, are drawn in isometric projection. The method as shown in Fig. 18 is as follows :

(1) A base line, representing the centre-line of the nut on its underside, is first drawn and on this line four points are marked corresponding to the width of the face of the nut and its two flanks. The dimensions for these points are taken either directly from the nut that it is required to draw, or from an orthographic projection of the nut. In addition, ■ vertical centre-line is drawn.

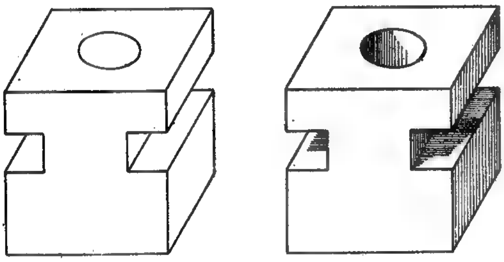


Fig. 19. To show the comparison between shaded and unshaded drawings

(2) From the outer points two lines are then drawn at 45 deg. and two vertical lines projected from the inner points to meet them. The two points of intersection are joined by a horizontal line as shown.

(3) The thickness of the nut must now be measured and drawn by first describing an arc with centre X and radius equal to the actual thickness of the nut multiplied by 0.8 to allow for foreshortening.

(4) Next, two vertical lines of the same length as those outlining the face of the nut are drawn from the outer edges of the flanks, and with the same radius ■■ in operation 3, arcs are described with centres ■ and b, and c and d.

(5) Again with the same radius, but with centres at the intersection of the arcs, two arcs are described joining ■ to b and c to d.

(6) With centre X^1 an arc is described joining a to d. A corresponding arc is also described with centre Y and the same radius.

(7) A horizontal centre-line is then drawn connecting ■ and d, and on this line the ellipse for the threaded portion of the nut is drawn together with the small arcs required to complete the upper surface of the nut itself. With practice the centres of these small arcs may be estimated fairly accurately, at least when drawing small nuts. In the case of large nuts, however, orthodox methods are essential.

(8) If it is required to show that the male thread projects slightly through the nut, this is done by drawing a semicircle with centre Z on the upper side of the horizontal centre-line, the half ellipse remaining on the lower side of this line. Further emphasis to the whole drawing may be given by shading as shown.

Shading Isometric Drawings

Shading, when carried out judiciously greatly improves any isometric drawing. As with other drawings, the light is considered as falling on the object from the left and some 45 deg. above it, the effect being to put the right-hand side in comparative darkness. An example of ■■ isometric drawing with and without shading is given in Fig. 19, and it will be seen that the vertical surfaces are given vertical shading lines whilst the horizontal surfaces are shaded by horizontal lines extending over those parts of the object that are in the shade.

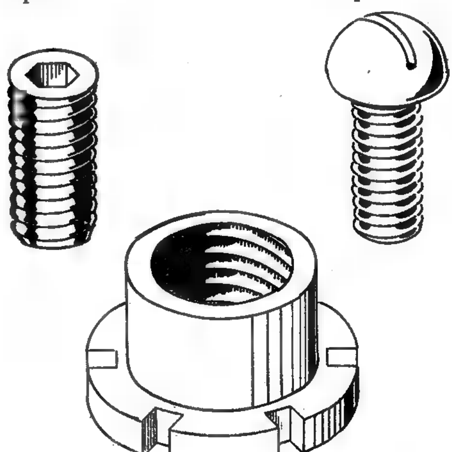


Fig. 20. Some examples of screw threads drawn isometrically

*Continued from page 182, "M.E.," February 9, 1950.

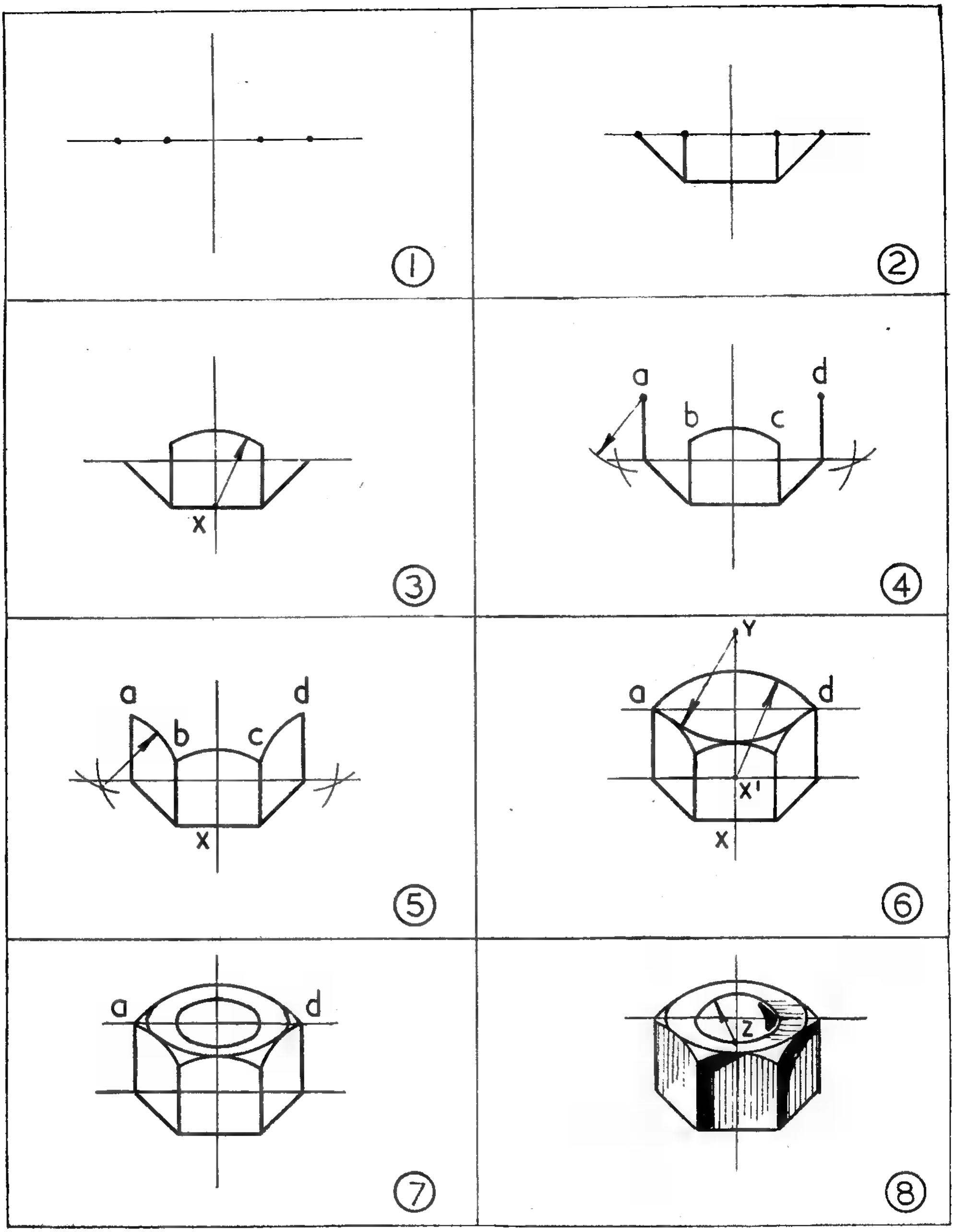


Fig. 18. *Method of drawing nuts isometrically*

Drawing and Shading Screw Threads

One example of treating isometrically drawn screw threads has already been given in Fig. 12B. Reference to this illustration will make it clear that orthographic methods for depicting screws are quite useless in an isometric projection.

There are many ways of shading such details, [redacted] glance at practically any modern motor [redacted] instruction book will show, and some representative examples are given in Fig. 20.

It is not essential to indicate the thread helix angle, though, undoubtedly, [redacted] far better impression is given when this is done, particularly when drawing to an enlarged scale.

If the individual illustrations in Fig. 20 are examined it will be seen that the threads them-

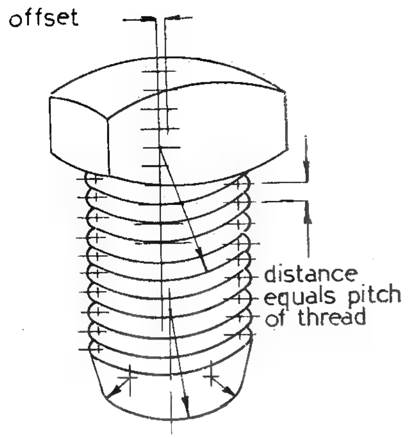


Fig. 21. Illustrating the constructional method of drawing screw threads isometrically

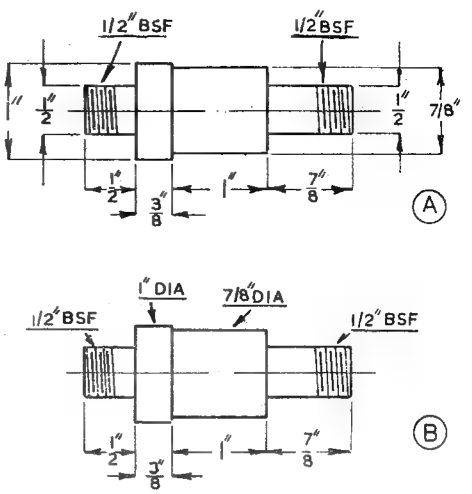
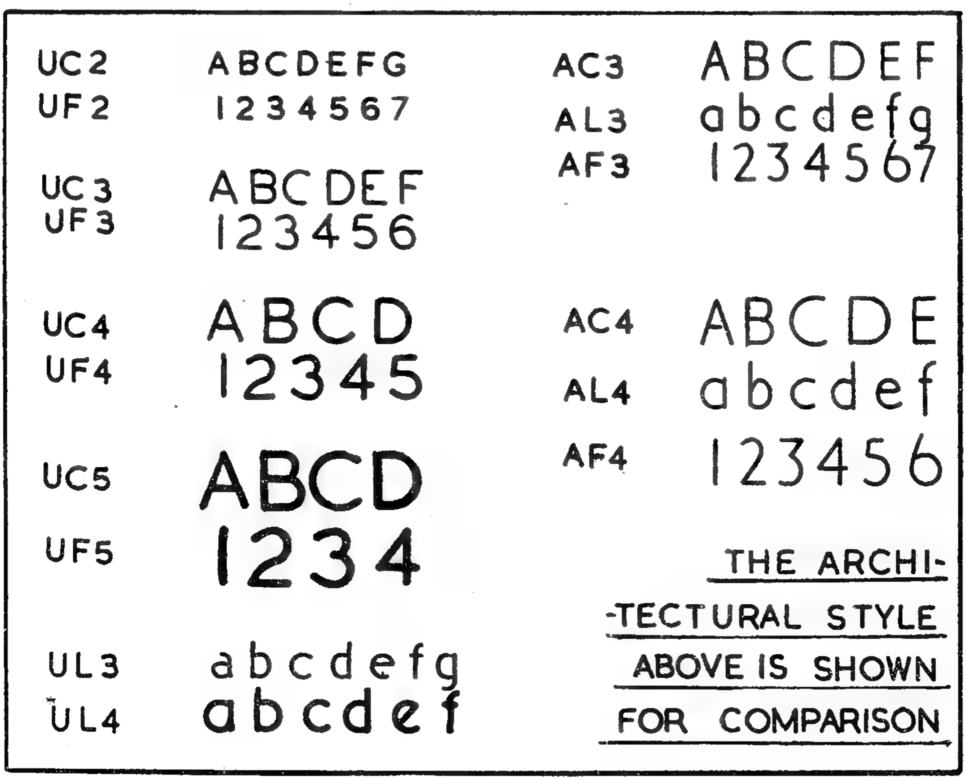


Fig. 22. Two ways of indicating dimensions

selves, are, in essence, made up of a number of ellipses stacked one above the other, the interval of the stacking being equal to the pitch of the thread. The constructional methods by means of which the threads are drawn is shown in Fig. 21 and it should be noted that the centres for the major and minor arcs for the ellipse forming the point of the screw are found by the method given in Fig. 16. Similarly the radius for drawing the crest of the screw threads is derived by analysing, on a separate piece of paper, an ellipse whose major axis is the same diameter as that of the thread to be drawn. The radius of the major



Some suitable sizes of stencil

arc of this ellipse will be that which is required, and it will be observed that the centres from which the arcs for the screw threads are struck are offset from the centre line of the screw, the amount of eccentricity being approximately 1/20 of the thread diameter. When drawing to a small scale the offset can be estimated. The centres for the small arcs which form the sides of the screw thread are best found by a process of trial and error, and when a suitable centre for one arc has been found the remaining centres can be pricked in.

Lettering and Dimensions

The size of lettering and figures is of the greatest importance. If too large, the drawing will be overcrowded and the details will become obscured. As a guide $\frac{1}{8}$ in. figures and letters should be used with average-sized components when these are drawn twice full size. When drawing a large component the figures should be $\frac{3}{16}$ in. or even $\frac{1}{4}$ in. high. Those with a facility for hand lettering will have no difficulty in selecting the correct size, but less experienced workers will no doubt prefer to use stencils and may find some guidance from the sizes given.

Drawings as issued to the commercial workshop must, of necessity, show every dimension so that no complaint can be levelled at the drawing office. On the other hand, drawings intended for publication are normally accompanied by text, therefore, some of the information usually found in a drawing may, with advantage, be included in the text itself.

Fig. 22A shows the usual drawing office method of indicating dimensions, whilst Fig. 22B demonstrates a modification which avoids obscuring the drawing itself and leaves the outline quite clear. For purposes of reproduction the latter method is usually preferable.

Dimension Lines

To avoid confusion, dimension lines should be drawn less heavily than the outline of the component. These lines should be kept as short as possible and with due regard to the placing of the actual figures. At the same time the outline of the drawing must not be obscured by placing the figures too close to it.

Stencils

Lettering done by amateur draughtsmen is seldom good enough, or even clear enough, for publication. Many otherwise excellent drawings are marred by untidy or uneven lettering and figuring. The use of stencils is, therefore, recommended to ensure neat and uniform results.

The most widely used pattern are the "Uno" stencils which may be obtained, together with suitable pens, in a wide range of types and sizes. It has been found that the following sizes are suitable for all ordinary work.

Height of letters	Stencil No.	Pen No.	Use	Scale of drawing
$\frac{1}{8}$"	UC2	1	Notes on dimensioned drawings	1 : 1 & 2 : 1
$\frac{1}{8}$"	UF2	1	Dimensions	1 : 1 & 2 : 1
$\frac{3}{16}$"	UC3	1	Reference letters and notes Titles on drawings	4 : 1 2 : 1
$\frac{3}{16}$"	UF3	1	Dimensions	4 : 1
$\frac{1}{4}$"	UC4	2	Titles on drawings Reference letters	4 : 1 2 : 1 &
$\frac{1}{4}$"	UF4	2	Reference numbers	4 : 1
$\frac{5}{16}$"	UC5	3	Titles on drawings	4 : 1
$\frac{5}{16}$"	UF5	3	Reference numbers (occasionally)	4 : 1

In addition for the legend attached to explanatory drawings, the two stencils listed below are used :

Height of letters	Stencil No.	Pen No.
$\frac{3}{16}$ in.	UL3	1
$\frac{1}{4}$ in.	UL4	1

For some classes of work architectural lettering may be preferred. It is a somewhat finer type and examples of this and the other forms previously mentioned are shown on the previous page.

Bolts, Nuts and Screws for Model Makers

Kennion Bros. (Hertford) Ltd., have favoured us with some samples of their very large range of bolts, nuts and screws, in brass and steel, which are produced specially for model makers. The range extends from 2-B.A. down to 12-B.A. in size, and in various useful lengths all of which are specified in detail in the firm's price-list and in advertisements that have appeared recently in our pages. Countersunk, cheese-head and hexagon-head screws and bolts, the latter complete with nuts, are included in the range, though not necessarily in every specified length ; but the standard of finish throughout is of commendably high quality of which the firm can be justifiably proud, and to which we would draw our readers' special attention. The prices are very reasonable, and we can confidently recommend the products from every point of view.

Shellac in the Home Workshop

by G. W. Arthur-Brand

MANY years ago, when serving a part of my apprenticeship in a West Indian sugar factory, I was scratching my head over the chucking of a small delicate job, when I observed the negro foreman peering indiscreetly over my shoulder. "Well," said I, "what would you do?"

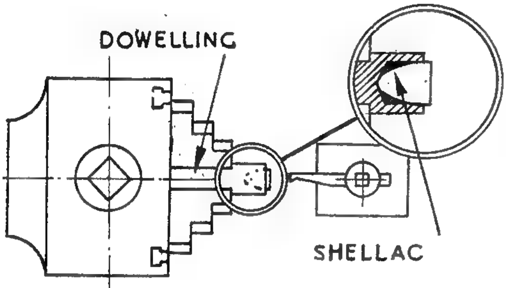


FIG. I.

"Use shellac, Jack," replied the foreman, as he left me with an air of contemptuous disgust.

Since that day, I have always kept a bottle of this very useful substance in my workshop, and when, through pressure of circumstances, I have been without a workshop, it has found an honoured place one one of the kitchen shelves.

Shellac is the outcome of an admixture of a number of compounds, formulated in an excremental discharge from the body of an ant, found mostly in parts of India, known as *Laccifer Lacca Kerr.* The secretions are taken from the branches and stalks of growing vegetable matter over which the ant has crawled.

Until the boom in plastics development, shellac was employed perhaps in greatest quantity by the manufacturers of gramophone records, the natural characteristics making for a binder offering a good, hard surface with a high resistance to scratching. Used electrically, due to its relatively low dielectric constant, it makes an unsurpassable binder for such materials as asbestos and mica in the production of excellent qualities of insulation, the outstanding quality being its ability to resist carbonisation.

But how, you may ask, does this help the average modeller in the workshop? The answer, of course, is a very simple and straightforward one: actually, it doesn't. You would not, however, employ a man to do vital work for you without first finding out something about him. Would it be unusual, therefore, to assume that before employing material aid, you might profit equally by a fair knowledge of its constituents?

Having decided this point for you, I will go on to tell you just a bit more about your subject before suggesting a few practical uses. Let us examine the properties of shellac, so that we may get a clear picture of what we might reasonably expect as the outcome of varied forms of treatment.

Properties

Specific gravity: 1.1-2.7; *Weight*: (per in.^{3}) 0.75-1.502 *zo.*; *Water Absorption*: Nil; *Dielectric Constant* (50 cycles): 3-4; *Forms available*: Flakes, slabs and powder; moulding powders or moulded slabs and alcoholic varnishes.

While it is to the latter that I intend to refer primarily in this article, perhaps a few words regarding shellac in relation to moulding will not prove altogether uninteresting.

Many model engineers, especially the internal combustion engine (largely power boat) fraternity, like to construct everything themselves, and in the construction of coils, shellac is undoubtedly the finest laminate. First rate coil formers may be produced by mixing the resin with a solvent, applying to paper board and curing at approximately 300 deg. F.

The compositions of shellac are true thermoplastics, though they are frequently combined with thermo-setting resins such as urea-formaldehyde and phenol-formaldehyde. The admixture is found to possess the characteristics of both materials, the chief of which is the ease and rapidity of curing, coupled with its aforementioned resistance to carbonisation.

Here are its properties as a plastic: *Moulding Temperature Injection,* 180 deg. to 260 deg. F. Compression, 240 deg. to 260 deg. F.; *Tensile Strength* (lb./sq. in.), 900-2,000; *Impact Strength* (½ in. × ½ in. bar), 2.6-2.9 (I); *Break-*

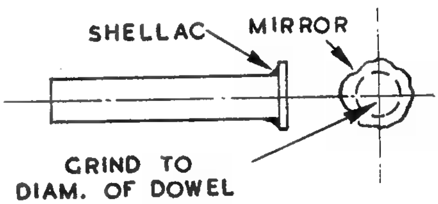


FIG. 2.

down Voltage (volts/mil. at 50 cycles); 250-600; *Shrinkage* (in./in.), 0.002; *Moulding Pressure* (lb./sq. in.) Injection, 1,000-1,500, Compression, 1,000-2,500; *Modulus of Elasticity* (lb./sq. in. $\times 10^5$) Nil; *Machining Speeds,* Drilling, 300-500 ft./min., Polishing, 200-1,000 ft./min.; *Cement,* Methyl-Alcohol.

Liquid Shellac

Having, I hope, convinced you of the importance and practicability of shellac as an everyday industrial asset, let us get back to the workshop and discuss how, by the help of its most com-

monly known form, we may resolve some of the many little problems that, from time to time, present themselves.

Example 1

You are making a rear-view mirror for your model car and you have formed a beautifully streamlined front fairing which you are at the moment, perhaps, mentally parting off. The thought suddenly occurs to you : How to face and recess the rear end to take the mirror. Take a look at Fig. 1. All that you require is a 3- or 4-in. length of good, straight, hard dowelling. Insert in chuck and with a drill of suitable size for the job in hand, dimple the dowel as shown, then simply apply shellac to both surfaces, unite and hold square with tailstock centre until set. When you have completed your turning, apply heat, indirect or otherwise, until the shellac melts and clean with methyl-alcohol.

Example 2

Having completed the frame and fairing, you decide that, instead of the dreadful tinfoil efforts seen on a large number of models, *your* special will have real mirrors fitted. Although, however, you are convinced that a good job could be done on a fine high-speed emery wheel, you have burnt your fingers trying to hold it, and anyway, the silvering is all coming off the back. What to do ? This is very elementary, really, when you know how. Again, a length of dowel—a slightly longer length this time, say 6 or 7 in.—of a diameter approximately equal to that of the mirror you desire to fit. Carefully face one end and apply shellac both to this and to the bright side or face of the mirror, then centralise and allow to set. The " mirror " to start will be a small, very oddly shaped fragment, broken, roughly to size. It may now be easily ground, in small doses, to the required size.

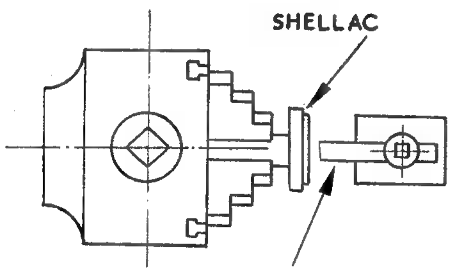


FIG. 3.

Make sure, however, that it does not get hot enough to melt the shellac ! Oh, and another tip ; prise the finished mirror from the dowel with a penknife and do not attempt to clean the face until you have fitted it. On no account apply heat.

Example 3

You are thinking of making some slip gauges, say, of $\frac{1}{16}$ in. and $\frac{1}{8}$ in. thickness, perhaps thinner than these. Referring to Fig. 3, machine first of all the o.d. and dress the face to the desired finish which, of course, should be as good as possible. Part off. Now remove the existing material from the chuck and take in a piece which will allow at least .25 in. all round the slip gauge, in other words, .5 in. larger in diameter. This will allow a micrometer depth gauge to be used to check the near-finished thickness. Machine the face to a finish comparable with that of the finished face of the gauge, apply shellac as before and centre. When dry, rechuck and finish with very light cuts.

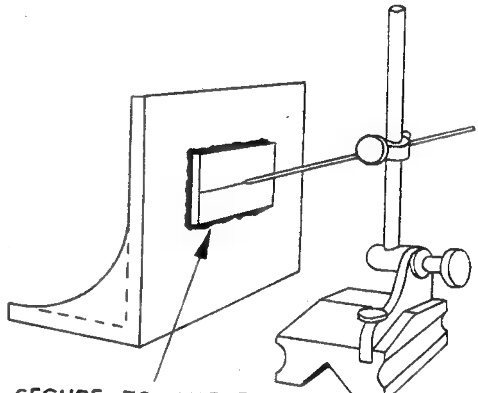


FIG. 4.

It was just such a job that I was engaged in doing when my old negro foreman flouted his words of wisdom at me. Yes, I know and I have done it, so do not say to yourselves, as so many others are inclined to, " it won't hold ! "

Example 4

One often finds oneself faced with the problem of marking out some small piece of work which is difficult to handle accurately due to its diminutive size. Here, as in Fig. 4, an angle-plate may be employed and with a spot of shellac on both surfaces, the job can be trued up at the required angle and left to set. By the application of the scriber-block, a far greater degree of accuracy will be obtained and crosslines may be marked out by turning the angle-plate on end.

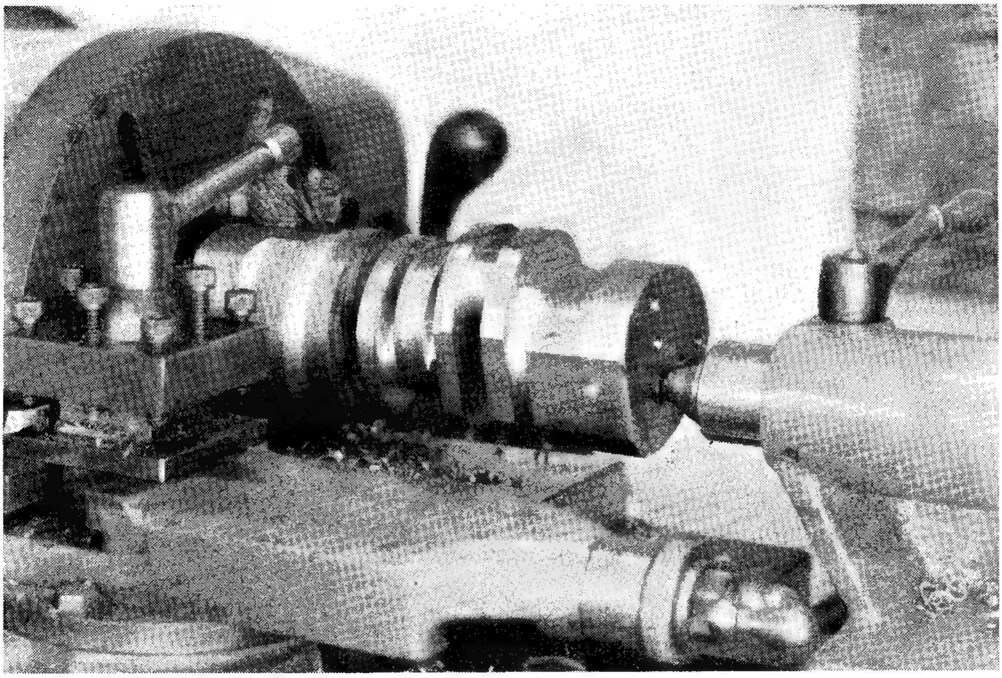
With the above four examples are scores of others which will suggest themselves to you, as time goes by. A book could be written on the practical uses to which shellac is answering daily, but in this article it has been my intention to encourage and, perhaps, to enlighten rather than to instruct.

As you lay this aside, it is not without the bounds of possibility that a number of other uses will spring to mind and perhaps, too, you will recall past jobs which, though at the time incredibly difficult to resolve, will in future take on the aspect of a mere flea-bite !

Turning a Crankshaft from the Solid

by H. Charnley, A.M.I.E.E.

SOME months ago, I decided to make the locomotive "Maid of Kent" as described by "L.B.S.C." However, instead of making the cranked axle as specified, I decided to try my hand at turning it from the solid, as I thought it would make an interesting turning job. I have now completed it and found it was a much bigger job than I at first imagined, the total time spent on it being forty hours.



View showing various centres

Dimensions of axle are as follow :—

Axle, 6 in. long; crank throw, 1 1/8 in.; eccentric throw, 7/16 in.; diameter of crankpins and axle journals, 3/4 in.; thickness of crank webs, 1/4 in.; and width of webs 1 1/4 in.; length of crankpins, 3/8 in.

I obtained a piece of bright shafting steel 3 in. diameter, 6 1/8 in. long when squared up. I discovered near the end of the job I should have made the length no more than 6 1/32 in., as the axle is 6 in. long, when finished; the 1/32 in. would have been ample to allow final facing both ends up, whereas the 1/8 in., i.e., 1/16 in. at each end, was rather too much; when finally faced up, the original centres were too small.

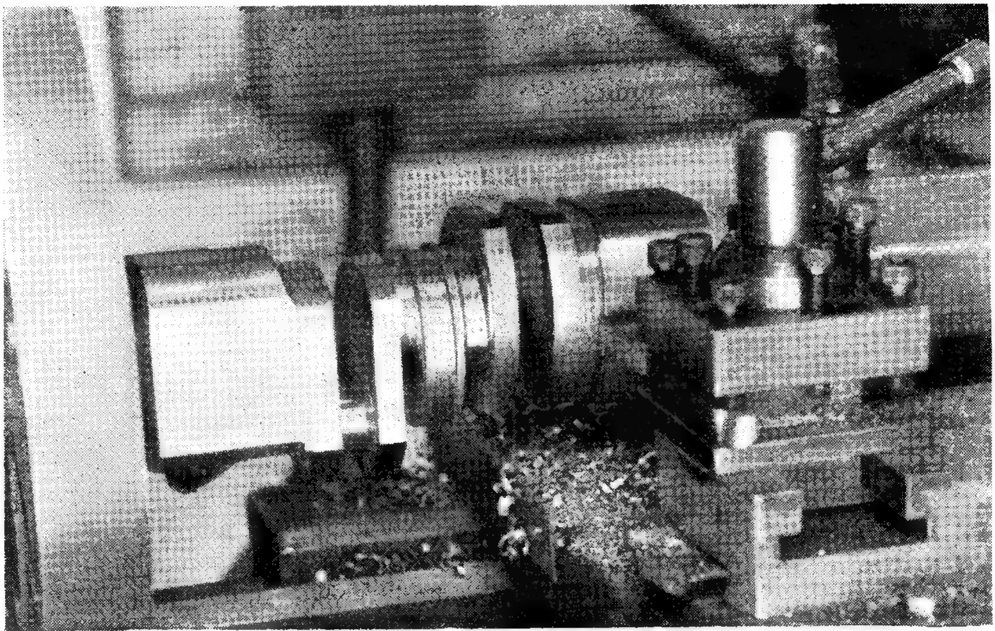
After getting the ends true and square I milled a flat, the full length and 3/8 in. deep from the circumference, this flat being about 2 in. across. I then milled another flat the same depth at exact right-angles to it, so that the piece would always lie flat and firm on my marking-out plate. As I intend to fit Joy's valve-gear only one eccentric will be required for the feed pump, and this has been turned solid with the rest.

So the ends were marked out with four centres, i.e., main axle centre, two crank centres and one eccentric centre. The two flats at right-angles to each other simplified this work. To ease the work on the lathe somewhat, I milled slots where the cranks would be, 5/16 in. wide, as the length of the finished crank pin is 3/8 in.

When the work was on the lathe, it was soon discovered that a 4-in. centre lathe was hardly big enough for the job. When mounted on the centres, the work fouled the saddle; so auxiliary centres were made between the axle centre and the crank centres. When the work was mounted on these auxiliary centres, sufficient metal was removed to allow the work to clear the saddle when mounted on the axle centre.

For turning the cranks, a tool was ground somewhat like a parting-tool, but made long enough to clear the webs.

One of the plates shows the axle about half completed. The various centres can be seen. After finish turning the cranks, diameter of the axle was turned at each end to 1 1/4 in.



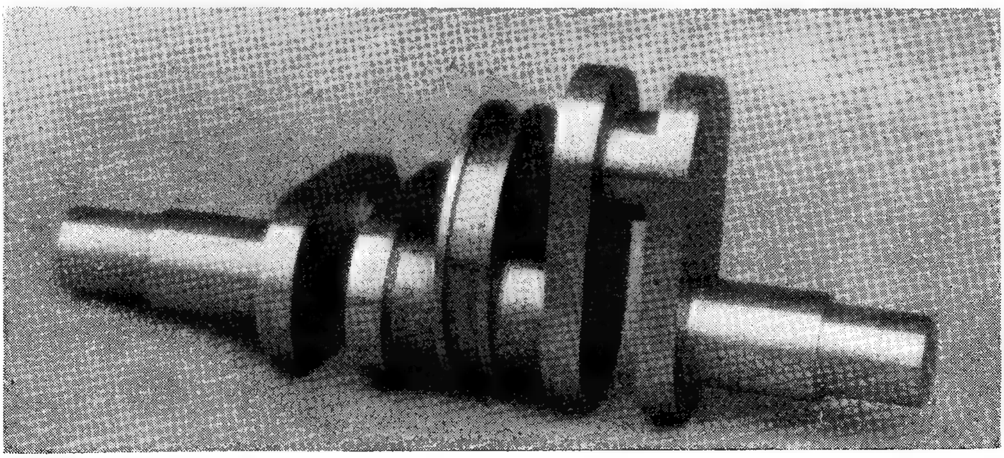
Machining metal away on auxiliary centres to enable work to clear saddle

At this stage, the work was removed from the lathe and put on the milling machine again, this time to mill the width of the crank webs to exact size. For this operation, the flats previously milled were useful in getting the sides of the webs correct in relation to the cranks; also, the 1½ in. diameter of shafts was ■ useful gauge for the actual width.

After this milling was completed, the work was put back in the lathe and the axle turned down to final size and webs faced up. Here I made another mistake. The crank centres were turned out before I had made the radius on the ends of the crank webs. So after finish turning, I had to fix two cast-iron discs on the ends of the axle.

To make the curves on the ends of the webs, the axle was mounted on centres on the milling table. A vertical end-mill was then presented against the end of the webs and the axle slowly worked backwards and forwards through 180 deg. This operation gave the webs a handsome appearance, as will be seen from the photograph of the finished crank axle.

The biggest mistake of all I have made is that, whilst the specification got out by "L.B.S.C." calls for the right-hand crank to be leading, I have made the left-hand leading. This will put the balance-weights on the cast-iron wheels in the wrong place, but I believe I can largely correct this by putting an additional balance weight on.



The finished crankshaft

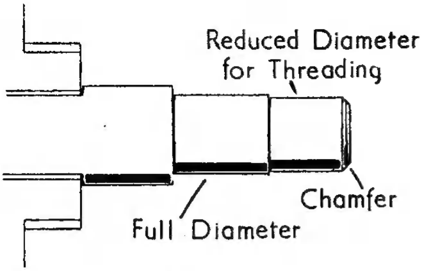


Fig. 1. Preparing the work for threading

Novices' Corner

Using the Lathe and Drilling Machine for Dieing and Tapping

THE methods used for cutting threads with taps and dies by hand were described in a previous article, and stress was laid on the necessity of maintaining these appliances in true axial alignment with the work; moreover, reference was made to the difficulties encountered in cutting the threads truly, and suggestions were made for overcoming these obstacles.

It will be clear that, if some means were adopted whereby accurate guidance were given to the tap or die, it would then be a relatively simple matter to form the threads correctly on the work.

This guidance can readily be obtained if the lathe is made to serve for tapping and dieing operations, and the drilling machine for tapping.

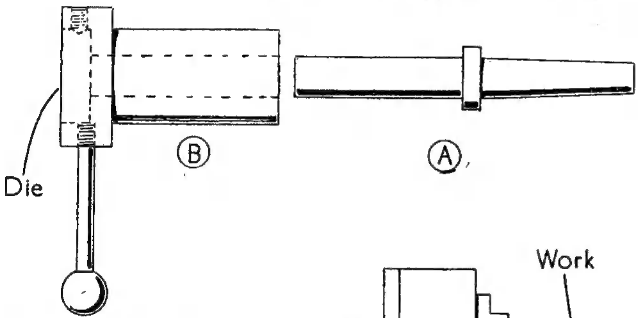
The tailstock die-holder consists of two main parts, as illustrated in Fig. 2: a tapered spigot *A* which fits into the tailstock barrel and carries the sliding die-head *B*.

The die-head is usually fitted with a handle to prevent the die turning when in operation, but, as an alternative means of serving the same purpose, a peg is sometimes fitted to the spigot to engage a slot cut in the die-head. In order to free the hands, the handle of the die-head may be brought into contact with the lathe top slide and the die thus prevented turning.

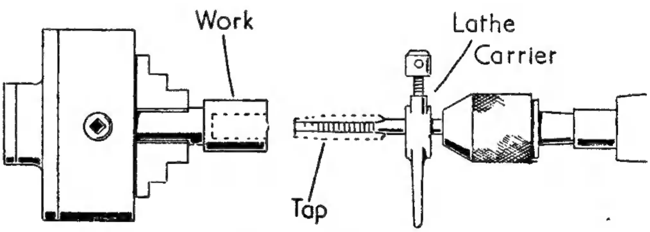
The die is secured in place in the die-head by means of three, pointed grub-screws. When threading steel, both the work and the threads of the die should be well lubricated with lard oil, or with some other kind of cutting oil.

To start the die, it is brought up to the work and the tailstock is fed forwards while the lathe mandrel is turned by hand. If the mandrel is turned by pulling on the belt, care must be taken to avoid the fingers being pinched, and a safer way, particularly when coarse threads are being cut, is to turn the chuck itself with the chuck key. As soon as the die has obtained a hold, it will travel along the work automatically as the mandrel is turned, but in the early stages it is advisable to maintain the tailstock pressure.

If the mandrel becomes unduly hard to turn, the work may be removed from the chuck and gripped in the bench vice to allow the threading to be finished by hand; for, once the die has obtained a good bearing on the work, it should continue to cut truly.



Above—Fig. 2. Lathe tailstock die-holder



Right—Fig. 3. Tapping from the lathe tailstock

Dieing in the Lathe

The work while held in the chuck is first turned to size, that is to say, the portion to be threaded is machined to slightly less than the nominal diameter of the thread, and the passage of the die will then compress the material and bring it up to approximately the true diameter.

This reduction of diameter should be about one thousandth of an inch for each ¼ in. of the work diameter in the case of steel, but a rather greater allowance can be given when threading brass, as this material is more compressible.

Next, as shown in Fig. 1, the end of the work is chamfered or bevelled to afford the cutting edges of the die an easier start.

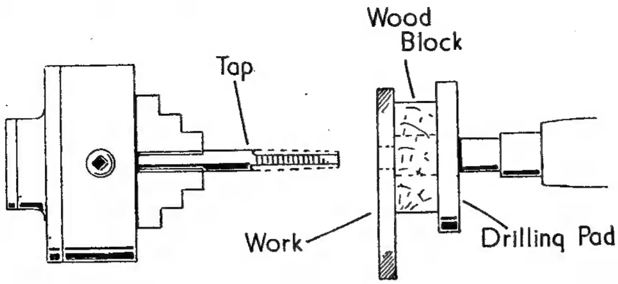


Fig. 4. Tapping from the headstock

Tapping in the Lathe

A tap can be guided by the tailstock in the same way as a die, but in this case, as illustrated in Fig. 3, the tailstock drill chuck is used to hold the tap in alignment with the work, mounted in the mandrel chuck. The usual application of this method is for tapping the end of a piece of material, such as a shaft, which has been faced and axially drilled from the tailstock.

The jaws of the drill chuck are closed on the shank of the tap sufficiently to afford guidance, but not to prevent the tap turning or sliding in the chuck.

A lathe carrier or similar fitting, firmly secured to the tap shank, is used either to turn the tap by hand or to stop the tap turning when the lathe mandrel is rotated and the tap remains stationary. When the former method is used, it may be found easier to turn the tap to and fro as threading proceeds. Should it become increasingly difficult to turn the tap forwards, then, as previously described, the threading operation may be completed by hand in the bench vice.

The lathe may also be used for tapping work supported by the tailstock. For this purpose, as shown in Fig. 4, the tap is gripped in the mandrel chuck and the work is aligned and supported by a drilling-pad fitted to the tailstock barrel. Care must be taken, however, to provide a passage for the tap as it emerges from the back of the work; a piece of wood with a hole drilled through it will, perhaps, best serve this purpose.

Tailstock pressure must be maintained, as the tap advances, to ensure that the work is kept in true alignment by being pressed against the drilling-pad.

Tapping in the Drilling Machine

The drilling machine is employed for tapping in very much the same way as the lathe was used in the preceding operation. As represented in Fig. 5, the tap is secured in the drill chuck and the work is aligned by resting on the drilling table. A passage for the tap is provided either by a hole formed in the drilling table, or a wooden block is used as in the previous instance.

The drill spindle is turned by hand either by means of a lathe carrier secured to the upper end, or a special handle may be made for the purpose. When attaching a lathe carrier in this way, it is essential to protect the spindle from damage by using a strip of sheet copper, bent into a circle and inserted in the carrier. If the return spring of the drill is detached, the weight of the chuck and other parts will help to maintain the downward pressure on the tap; but, should this be found insufficient to start the tap, additional pressure can be applied by means of a foot stirrup consisting of a looped cord attached to the feed lever of the machine. This is made necessary by the hands being occupied in holding the work and turning the drill spindle.

So far, the drilling machine has been turned by hand, but for some light tapping operations the machine may be run under its own power. For example, when making a batch of small nuts, the drilled nut blanks are supported on the drill table and gripped, one at a time, with a small spanner to prevent their turning.

As before, a hole in the drill table, or in the supporting block, forms a through-way for the tap.

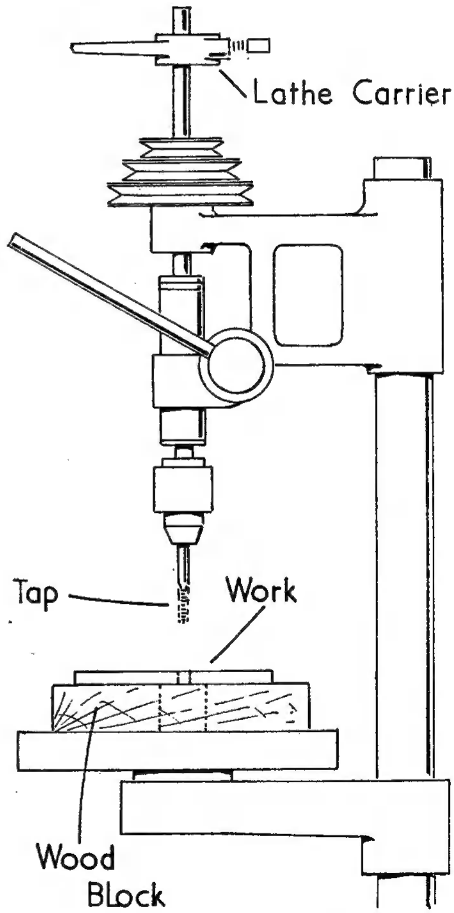


Fig. 5. Tapping work in the drilling machine

PRACTICAL LETTERS

The G.W.R. " Castles "

DEAR SIR,—I was very interested in your " Smoke Ring " in THE MODEL ENGINEER, *re* ex-G.W.R. " Castle " class locomotives.

I have a $2\frac{1}{2}$-in. gauge " Castle " nearly finished—only the trimmings required—and can state that the small one's performance appears to be quite up to " Swindon Standard," though I haven't had a chance as yet of a track test.

The only real difficulty I experienced was the valve-gear, but after rubbing holes in several sheets of drawing paper, I schemed out a correct inside Walschaerts gear, similar to the prototype. The mechanical lubricator set me guessing as to where to put it, till I saw that the prototype has a small crank working off the offside trailing coupled wheel; that solved the problem.

The boiler is scale size external and " L.B.S.C." internal and though the firebox is the narrow type it steams the four cylinders easily and with steam to spare. The cylinders are 11/16 in. bore $\times$ $1\frac{1}{8}$ in. stroke which is practically scale size. Needless to say, they are to our friend, " L.B.S.C.'s " " words and music."

I endorse your remark of a few weeks ago, stating that ex-G.W.R. locomotives are difficult to model, but I find photographs help immensely, augmenting my first hand knowledge. It is very interesting to me to see ex-G.W.R. locomotives mentioned as it seems that very few " live steam " enthusiasts favour them.

Yours faithfully.

Christchurch. S. MATTHEWS.

[Our correspondent is certainly resourceful in adapting the use of the small crank on the off-side trailing wheel. In the prototype, this crank is for driving the speed indicator, whereas, in the above model, it is adapted to drive the mechanical lubricator. It is little ingenuities of this kind which add a lot of interest to the problem of reproducing correct prototype detail, even if, in miniature, its use is for other purposes.—ED. " M.E."]

Vertical Boiler Roller

DEAR SIR,—I was very interested to see the photograph of a vertical boiler roller in THE MODEL ENGINEER for November 24th, and thought your readers may like to know that there is a similar roller in Jersey, Channel Islands; it is almost identical to the one in the photograph taken in Calcutta. It is made by Aveling & Porters of Rochester. I was unable to find out the year, but it is estimated to be 50 years old, and I am pleased to say has just been overhauled by an engineering firm in St. Helier and given a new lease of life. It is owned by a firm of contractors and I understand is to be used in a contract job in the Port of St. Helier before going up to the airport on work there. I was very lucky to be going ashore in the Island the other afternoon just as the fitter and his mate were making final adjustments outside of the workshop, and setting the safety-valve to blow at 75 lb. per sq. in., and having a good head of steam up, just before trying it out, and I must say she seemed to have plenty of life in her yet.

The engine is a twin-cylinder piston valve type mounted horizontally beside the boiler with a hinged cover over it like the half bonnet of a bus, and it is controlled by a small handwheel on the usual screw-down stop-valve on the main steam pipe from the boiler. The crankshaft is geared down to the front roller through gear wheels with a guard over the off side. The front roller itself has a brake drum on one end and ordinary shoe brakes connected by rods to a foot pedal which also has a hand wheel attachment as well to hold it on or apply more pressure. Steering is by a tiller and horizontal screwed shaft, worked by a wheel on the off side. The tray in front of the boiler is for coal and beneath it, forward of the roller, is a water tank. Both rollers have sprinkler pipes fitted over them and the boiler is fitted with a whistle like a railway engine.

I look forward in the future to seeing it doing useful work in the Island, and no doubt if any readers should be over in Jersey for a holiday this year they will keep a weather eye open for it.

Yours faithfully,

London Dock. P. BENNETT.

DEAR SIR,—With reference to the photograph in " Smoke Rings " of the vertical boilered steam roller shown in India—there was one in this country that did valuable work during the war. I was stationed at R.A.F. Fairwood Common, just outside Swansea, and this roller, identical to your photograph as far as I can remember, was in constant use repairing the runways and perimeter track.

Perhaps the Swansea Society could sort it out and get some dimensions.

Yours faithfully,

Bournemouth. H. BRISTOW.

Interest in Old-Timers

DEAR SIR,—Your editorial notes on the " Steam Traction Engine," lead me to suggest that this increasing love of old things is not mere sentimentality, but rather the recognition of an intrinsic value in certain things originally created for utility purposes. This recognition has its roots deep in the imagination and promotes a desire to keep the image of the admired object in view, and to isolate it from the normal process of progress and obsolescence. Thus it becomes no more " reactionary " to admire, and preserve such objects with affection than it is to love the Welsh mountains, the seashore or the English rose.

Three qualities seem to qualify a mechanical object for this regard, namely: (*a*) a history; (*b*) a simple theory; (*c*) an enduring construction. Modern tendencies toward complicated theories and high efficiencies with a limited individual life, mark a real change, away from these ideals.

So, I believe the time ripe for the formation of a new " National Trust " for preserving and

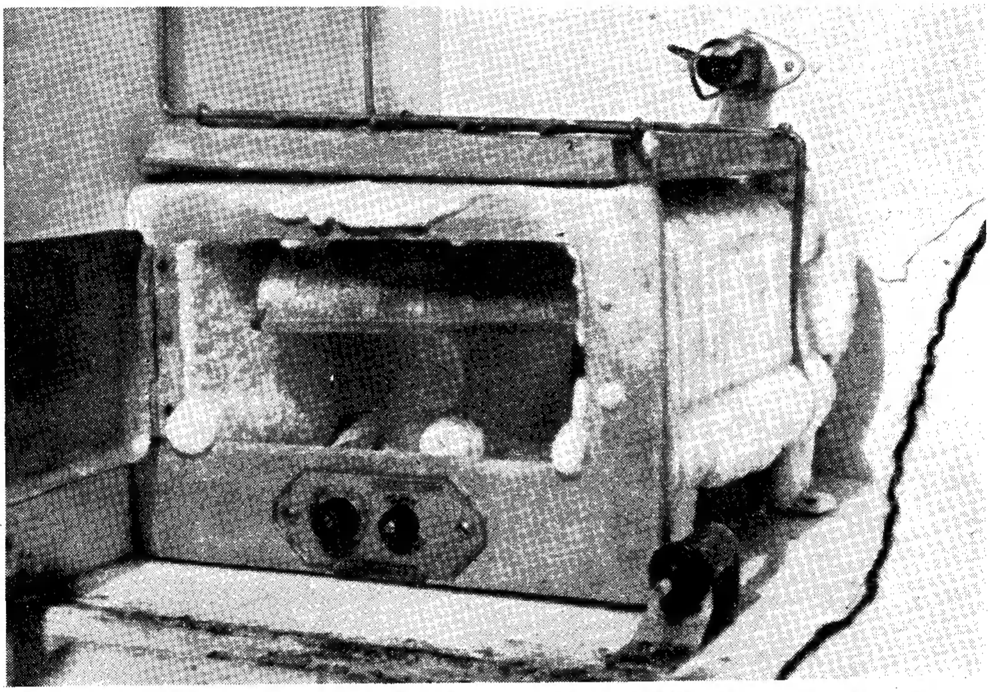
fostering the appreciation of "Industrial Folk Lore" (for want of a better term!). Its work would cover the following :—

Marine : Deep-sea square-rigged sailing ships, schooners and coasters, Thames barges, Norfolk wherries, Yorkshire sailing cobles, Mersey "Nobbies" and sailing "flats," Humber sloops, Scottish sailing, fishing craft, luggers, decorated narrow canal barges, etc.

Railway : Country branch lines, narrow gauge railways, historical locomotives and rolling stock, old tramcars, etc.

Road : Stage coaches and horse-buses, the traditional "county" farm cart, early motor cars, steam traction engines, etc.

Stationary : Windmills and waterwheels, steam beam and table engines, old craft workshops, sail lofts, etc.



Many enthusiastic societies are doing fine work in these various fields individually, but the "Trust" I suggest would provide a control liaison, accumulate funds for grants, collect data and publish guide books. A work of inestimable value to model makers, film producers, artists and writers, tourists and schools in the years to come.

Yours faithfully,

Huddersfield. W. B. STOCKS

A Domestic Refrigerator

DEAR SIR,—With reference to Mr. L. C. Sherrell's articles, which I have followed with great interest, may I be allowed a short comment?

When Mr. Sherrell, in THE MODEL ENGINEER of December 22nd, complains that his first evaporator was not efficient, it looks more like quite the opposite. Unless there was frosting of the suction line outside the cabinet the trouble was most likely with the expansion valve. The cabinet, compressor, cooler, evaporator and *expansion-valve* should, as stated by Mr. Sherrell, be regarded as a whole. The valve ought to be adjusted not to a given pressure, but to suit the evaporator.

With the pressure and the gas chosen, the evaporator seems to be too big and to fully utilise its size, an expansion-valve with a larger seat is necessary. With a seat diameter of 0.040 in. the expected approximate refrigeration capacity is 7,500 B.Th.U. per hour with SO_2, but only 6,000 B.Th.U. per hour with methyl chloride, CH_3Cl.

The coil evaporator is, of course, so much easier to construct, but generally not considered so efficient, which accounts for the easier total frosting.

To prove my point, the photograph reproduced herewith shows the prototype evaporator well frosted, due to a correctly adjusted expansion-valve. This evaporator has now worked for five years without any trouble.

Mr. Sherrell must have got his pressures a bit mixed. If the expansion-valve opens at 8 lb. abs. the temperature in the evaporator will be -40 deg. F. with methyl chloride and -10 deg. F. with sulphur-dioxide. If, on the other hand, 10 deg. F. is the wanted temperature in the evaporator, the pressure should be 23 lb. abs. (8 lb. on the gauge, i.e., over atmospheric pressure) for CH_3Cl and 2.6 in. mercury, i.e., under atmospheric pressure for SO_2.

Yours faithfully,

Drogheda. E. MEYLAND-SMITH.